Design Course

Pop-Up Design

Mechanism Paper Transformation to 3D Sculpture

by
Mugdha Kale
IDC, IIT Bombay

Source:
https://dsource.in/course/pop-design

1. Introduction
2. History
3. Tools and Materials
4. Techniques
5. Types of Pop-Up Design
6. Links and References
7. Video
8. Contact Details

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Source:
https://dsource.in/course/pop-design-0/introduction

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Introduction

Imagine opening a card or a book & the paper starts moving and folding to create forms which leave us with a feeling of wonder and awe. This seemingly magical movement of paper to create shapes & objects has captured the imagination of both young and old since ages. These are commonly known as pop-up or paper mechanisms. Pop-up mechanisms are defined as the transformation of paper from a folded, flat two-dimensional (2D) object to a three-dimensional (3D) sculpture when a book/card is opened. It is often used to design, communicate and represent 3D visual forms (e.g. drawing, painting, photograph or images) using folding and moving 2D shapes. It is considered as one of the most effective ways of artistically impressing and expressing aspects of a text, poem, story or idea when words fall short. Hence it is widely used as a supplement to text in books and greeting cards. This module will attempt to cover the commonly used techniques and mediums used in this beautiful craft.

Ref: http://mentalfloss.com/article/65074/10-pop-books-are-works-art (as seen on 4/5/2017)

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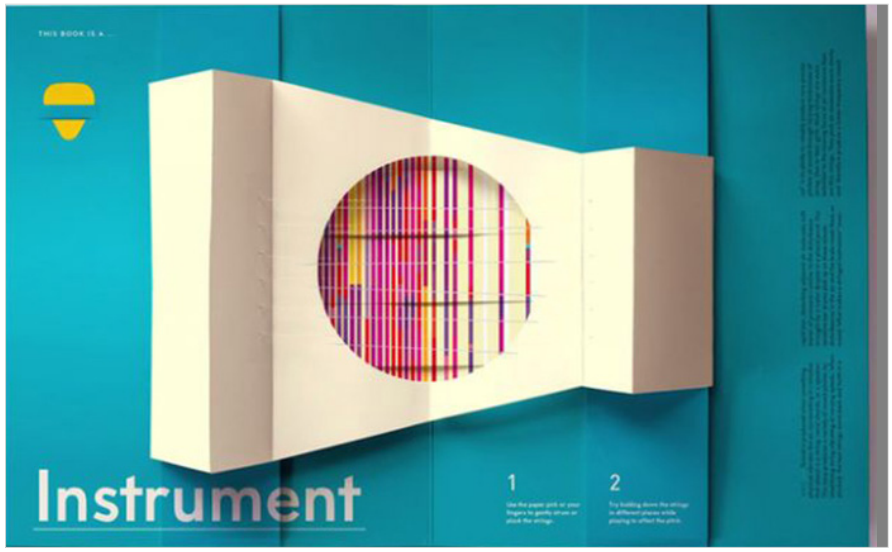

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History

Though we have records of gatefold mechanisms being used in encyclopedias in 1100, these can't be called pop-ups in the true sense. The first known recorded use of paper mechanism was in an astrological manuscript in the year 1306. Since it was increasingly used to depict ideas in serious texts, these mechanisms were exclusively used in books for adults. Even though pop-ups were used in books, it was only in the 18th century that pop-ups were used not just as an informative tool, but also an entertaining one. This is when we find the first books with pop-ups for children. But it was only after 1810 that the golden age for pop-ups began, a lot of mass-produced paper-engineered books were created during this era for both children and adults. After a brief lull during and after world wars, the second golden age of pop-ups began in 1965 when paper engineering was used in cards and advertisements. This led to the pop-up products that we see today.

Visual timeline of important milestones with creators and creations:

1100 - Gatefold opening used to depict Globus Terre in Liber Floridus (c1121).

Ref: *https://uk.pinterest.com/pin/443886106992270451/* (as seen on 4/5/2017).

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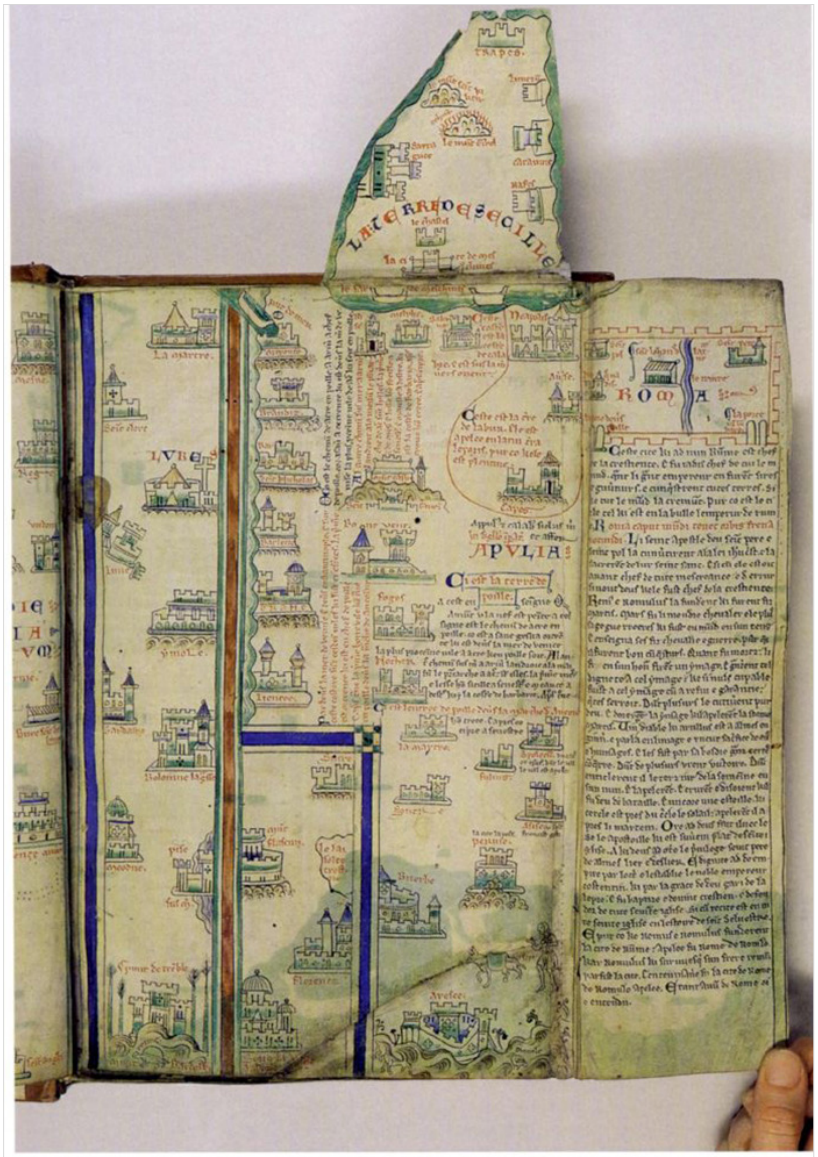
1200 - Gatefold opening used for in maps of pilgrimages by Matthew Paris (1200 - 1259).



5 Matthew Paris, *Chronica majora*, Itinerary from Italy, Rome, and Apulia, fol. 3r, with flaps open

Ref: *http://escholarship.org/uc/item/6g23b4fs* (as seen on 4/5/2017).

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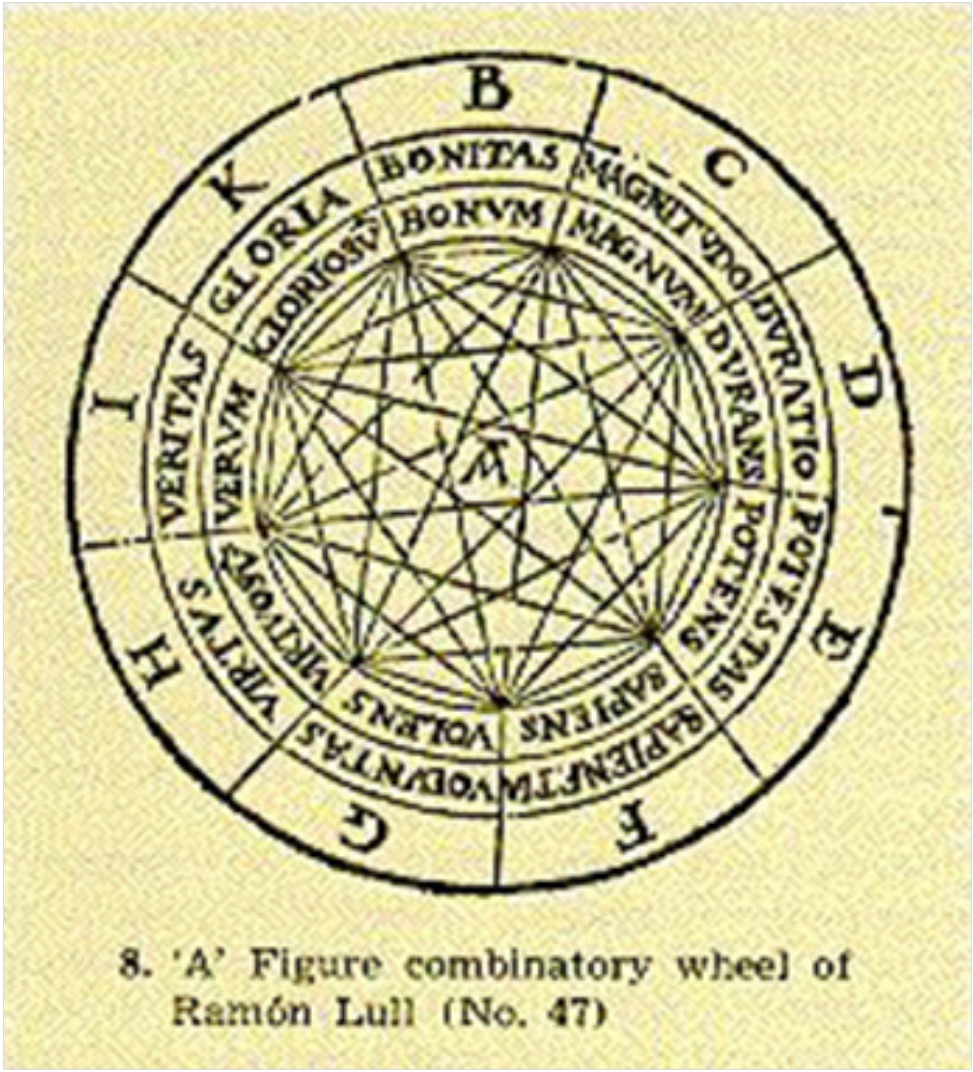
1300 - Volvelles used as an organizing tool by Ramón Llull (1235 - 1316).



8. 'A' Figure combinatory wheel of Ramón Lull (No. 47)

Ref: *https://in.pinterest.com/pin/488359153312951283/* (as seen on 4/5/2017).

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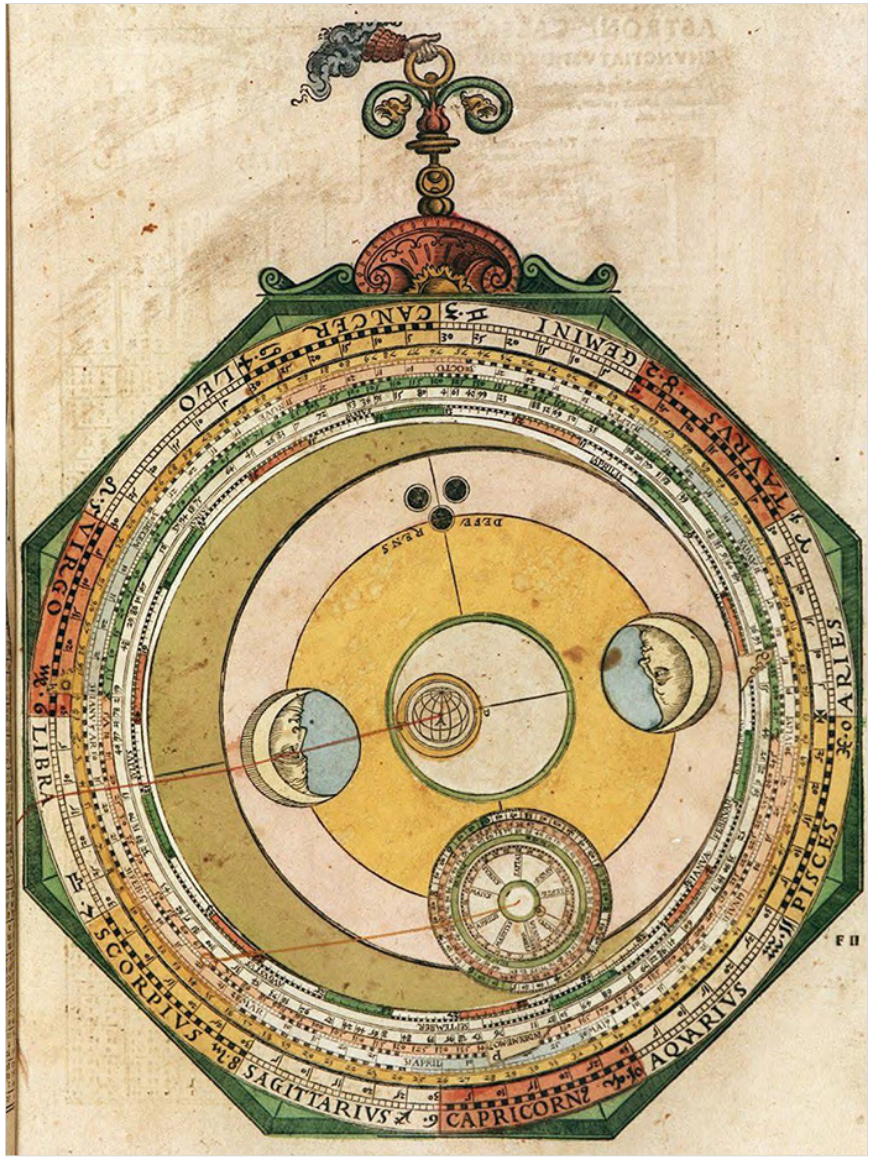
1540 - Volvettes used to potray the motion of the heavenly bodies in Astronomicum Caesareum by Petrus Apianus, aka Peter Bienewitz.



Ref: *https://commons.wikimedia.org/wiki/File:Astronomicum_Caesareum_(1540).f14.jpg* (as seen on 4/5/2017).

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1765 - The first movable book for children (generically called Harlequinade) by Robert Sayer using folded paper flaps.

Ref: *http://hndartandtime.blogspot.in/p/academic-essay.html* (as seen on 4/5/2017).

1800 - First Golden Age of Pop-ups.
The history of little fanny, by S.J. Sayer in 1810, led a wave of using pop-up elements in books.Some of the notable publishers in 19th century were, - Earnest Nister.

Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017) - Raphael Tuck.

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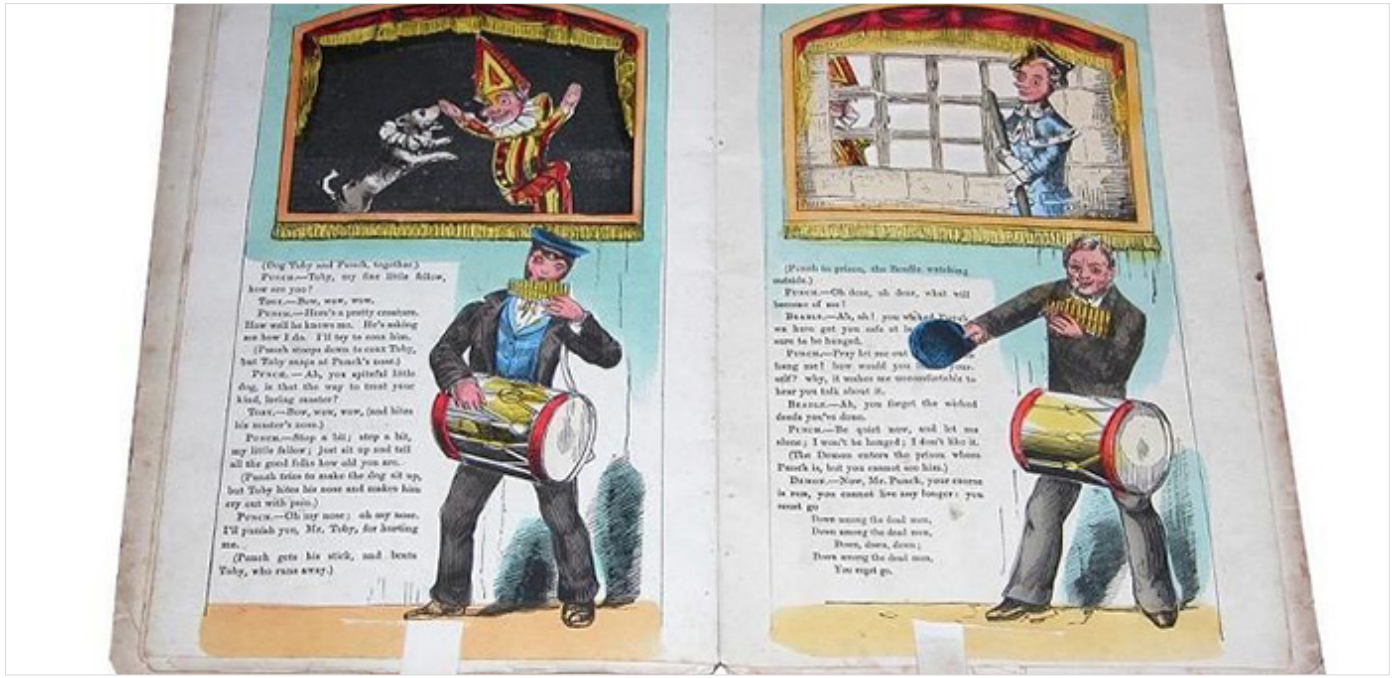
Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017)- Dean & Sons.



Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017) - McLoughlin.

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Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017).

1888 - Internationaler Zircus, the masterpiece of Lothar Meggendorfer (1847 - 1925) was published. He created some of the most complex mechanisms in this genre.

Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017).

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1929 - True pop-ups (activated by page turning) were published by S. Louis Giraud (1879 - 1950).

Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017).

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1932 - The term pop-up was copyrighted by Blue Ribbon Press.

1950 - Vojtech Kubasta, one of the most influential pop-up book designer of 20th century starts publishing pop-up books.

Ref: *http://emopalencia.com/desplegables/historia.htm* (as seen on 4/5/2017).

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1965 - The second golden age of pop-up begins. Graphic International started using pop ups for advertising. This company was formed by Waldo 'Wally' Hunt who was heavily influenced by Kubasta's work.

1994 - The Movable Book Society is formed by Ann Montanaro for collectors, artsts, librarians and packagers.

1998 - Robert Sabuda wins the first Meggendorfer prize (awarded by the Movable Book Society) for his book "The Christmas Alphabet'.

Ref: *https://bakedcottonstar.files.wordpress.com/2011/11/moma-card-2.jpg* (as seen on 4/5/2017).

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Tools and Materials

Following tools and materials used in Pop-up Design:

• Paper: Type: Color tinted paper, cartridge paper, card paper.
Thickness of the paper: should be between 135 - 220 gms, 35 gsm and 220 gsm

• Paper Cutter: Type: either a standard appear cutter or x-acto blade or paper scalpel.

• Cutting Mat: Standard A3 or A2 size cutting mat (select depending on the size of book or card) is recommended however in case of unavailability of the same, a cardboard from a used book would be adequate.

• Scissors: Conventional paper scissors or scalpel.

• Ruler: Steel ruler is preferable as it can be used to keep the paper in place and also to crease.

• Glue: Preferably use glue that dries quickly (water based glues generally take a longer time to dry).

• Art material.

• And colours and textures of your choice.

• Scoring and Creasing: Use a creasing tool or the tip of an empty refill for the best results.

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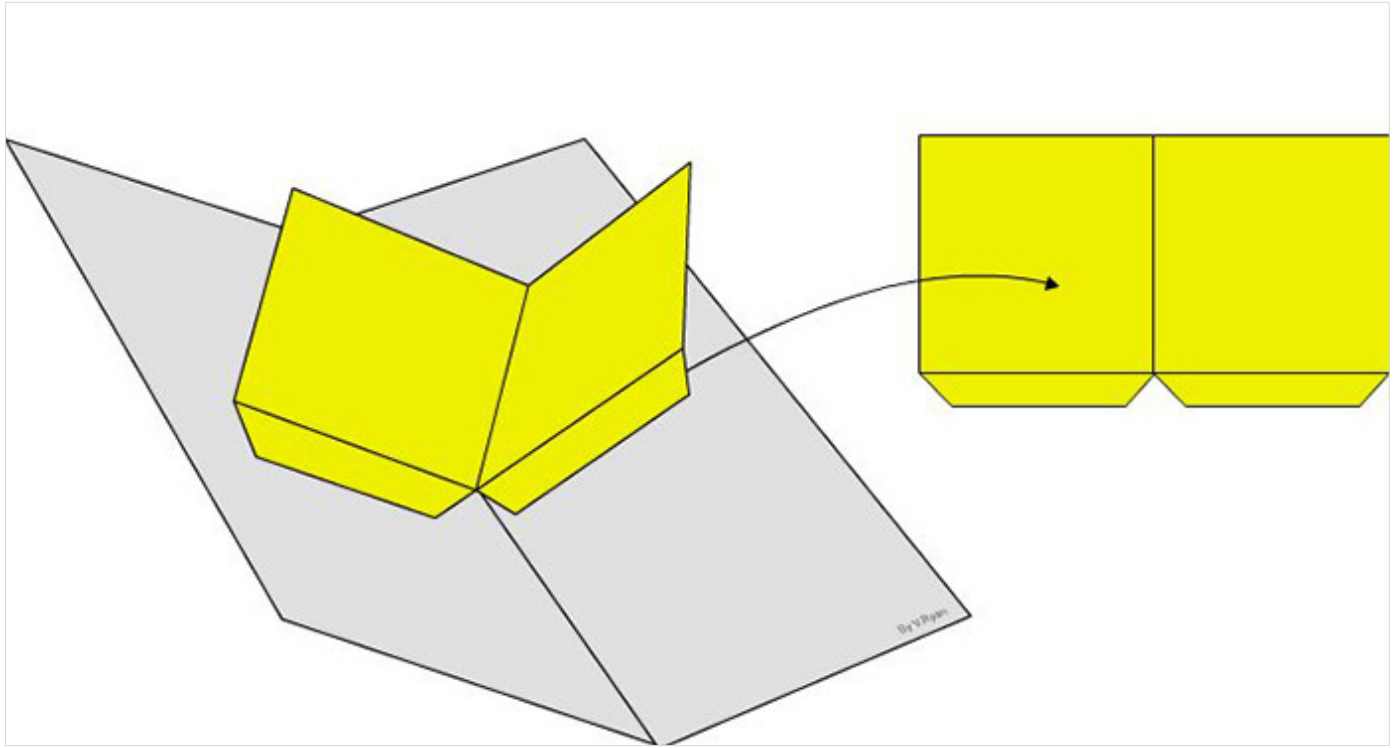
Techniques

Things to Remember

1. Basic Fold Techniques
2. Explore and Experiment
3. Enjoy the Process

1. Basic Fold Techniques:
Folding for pop up can be classified into two primary techniques, V-fold and parallel fold.

V Fold: In a V fold all the creases of the fold converge to a point on the spine of outer page or card.



Ref: *http://www.technologystudent.com/designpro/popup1.htm*

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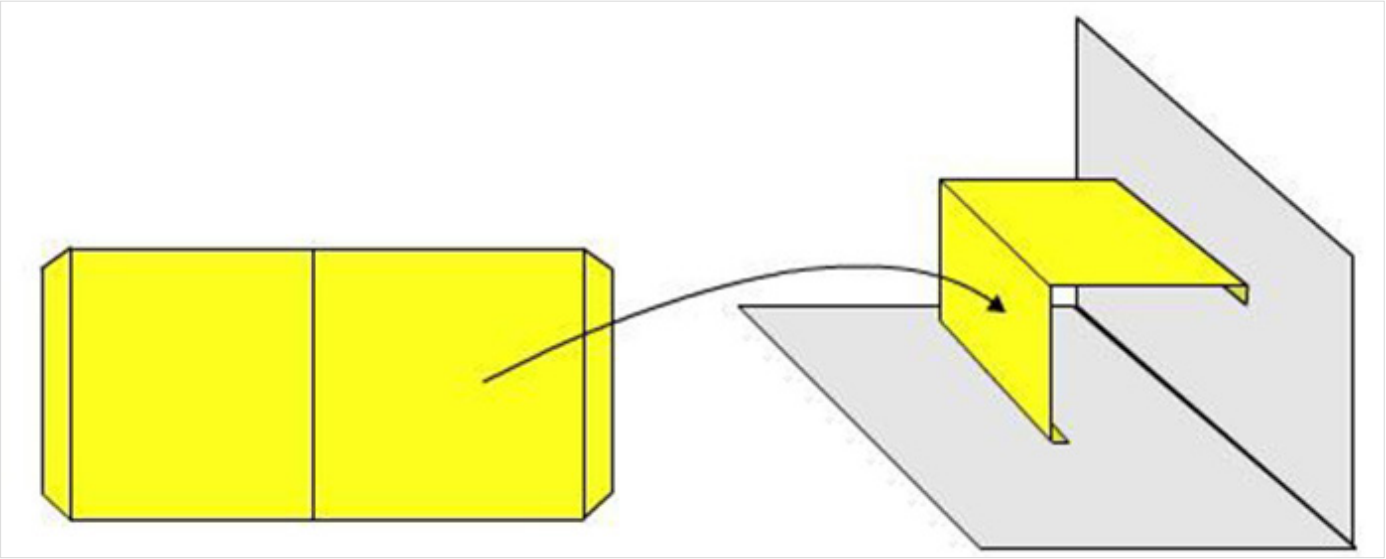
Depending on the angle of the fold at which they were stuck, they can be classified into right angle, acute, obtuse (acute makes the fold lean backwards and obtuse makes it lean forward when the card is opened), asymmetric and pointed V folds. Other variations of this folding technique are zigzag fold and M-fold.

Parallel Fold: In a parallel fold all the creases are parallel to the main spine of outer page or card.



Ref: *http://www.technologystudent.com/designpro/popup1.htm*

Depending on the distance at which both creases are stuck from the main spine, they are classified into three types, basic parallel fold, parallelogram and asymmetric parallel folds. Other variations of this fold include box fold and floating planes.

2. Explore and Experiment:
Paper engineering is one of those crafts which rewards patience and accuracy in work. To achieve desired effects from 2D drawing to 3D form, you need to be very patient and give yourself enough time to understand the folds and cutting.

3. Enjoy the Process:
It is very important to enjoy the process as you get to learn many things while doing it. Let mistakes happen, who knows you might find new technique to express your ideas. And last but not least, feel good about your artwork it will inspire you to make many more!

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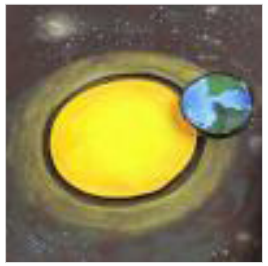
Types of Pop-Up Design

Paper Cutting and Folding

Paper Pop-ups and Folding



Paper Surface Mobility and Folding

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Paper Cutting and Folding

Though paper cutting and folding does not completely conform to definitions of pop-up, it is an easy and exciting way of quickly creating 3D shapes and movements in cards. This unique way of cutting and folding was created in Japan by Prof. Masahiro Chatani and is influenced by paper mechanisms, origami and architecture. This gave rise to a genre of pop-up called origami architecture.

Origami architecture involves the three-dimensional reproduction of architecture, geometric patterns, everyday objects, or other images, on a single sheet of paper. It makes effective use of light and shadow along with geometry to create intricate shapes and patterns.

After reading and referring to the books written by Prof. Masahiro Chatani, we tried few basic origami architecture paper folding techniques. Some basic warm-up techniques before you start pop folding and movable folding techniques are provided below. (For more details you can visit his website or buy books).

A. Basic Square

Step 1: Take any colour tinted or cartridge paper (thickness of more than 130gsm) fold it in half and press it firmly.

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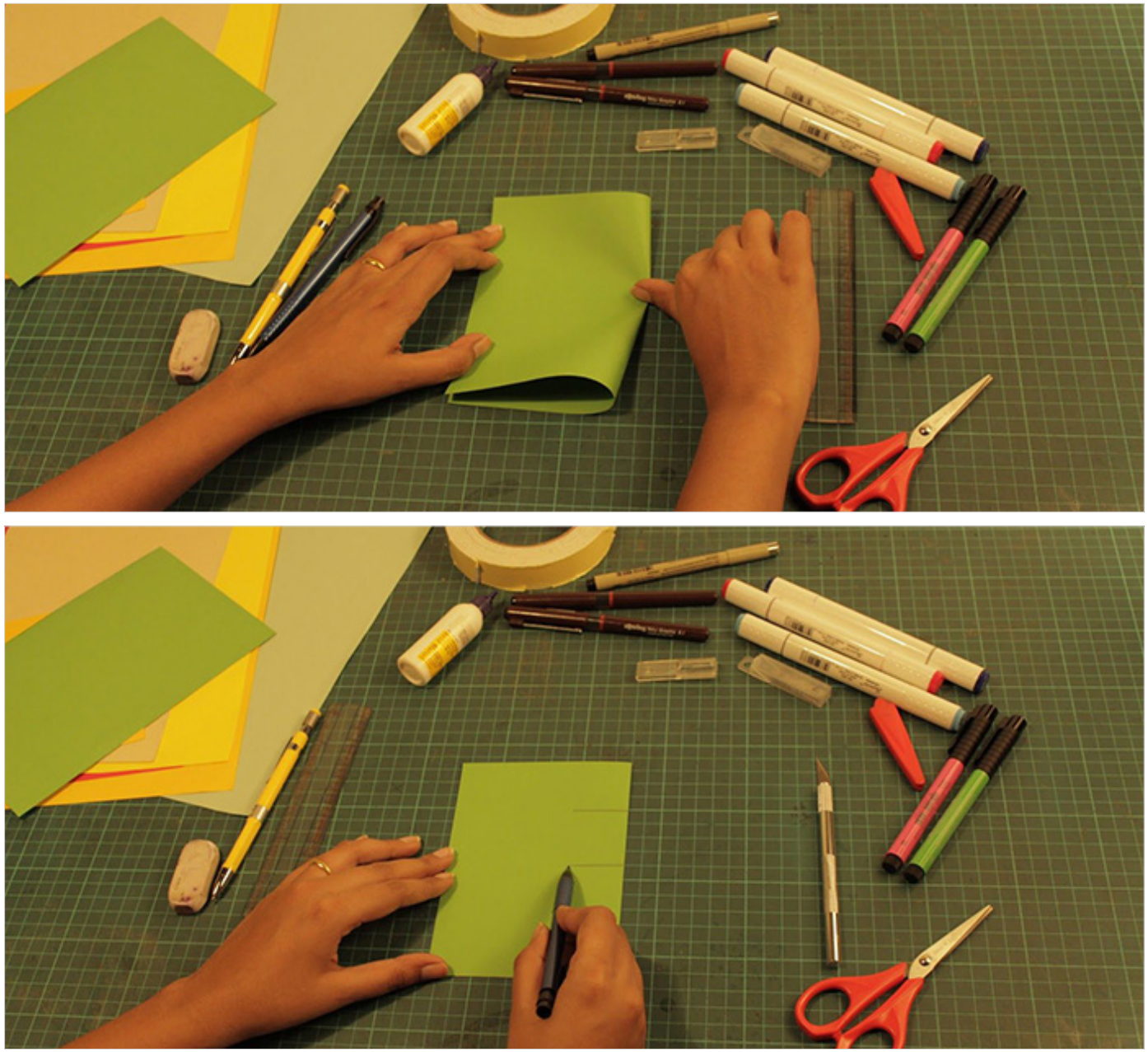

Step 2: Draw a basic square shape on the half side of the paper.

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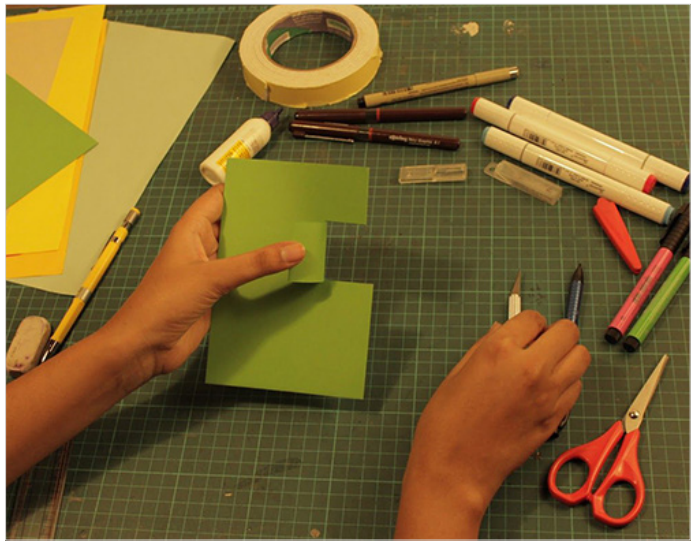
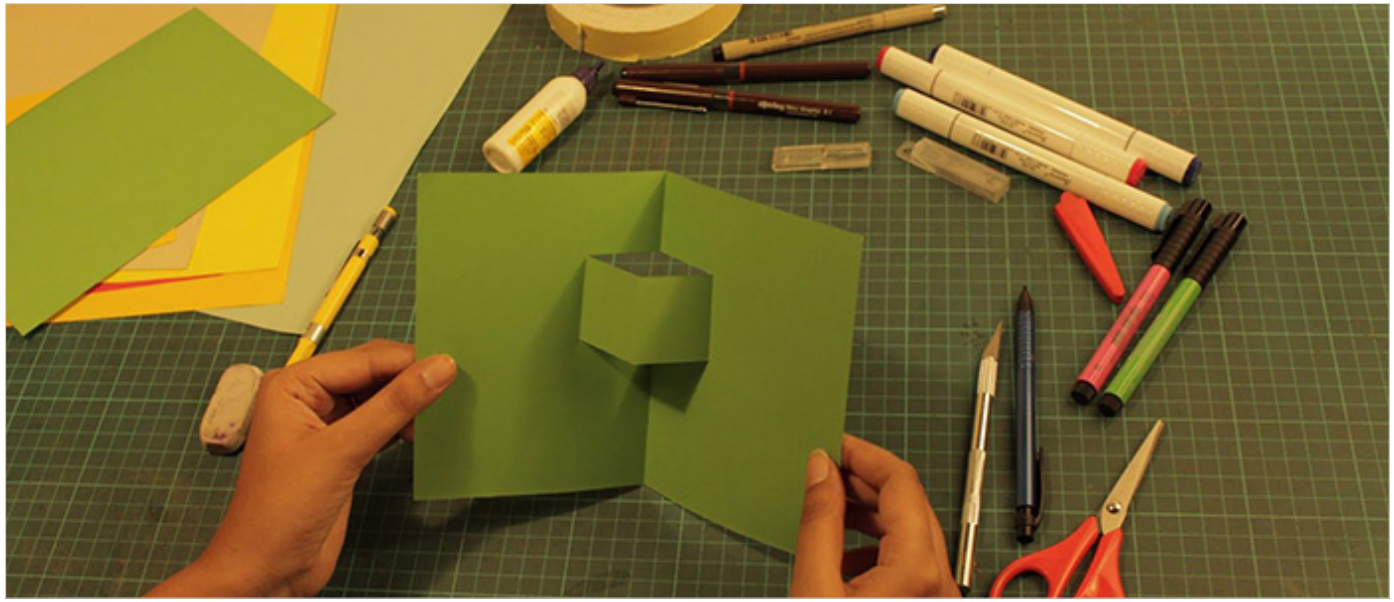


Step 3: With the use of a cutter or scissor cut it from both sides as you can see in the picture.

Step 4: Open the cut part on your left side and press it firmly with the use of a thumb or scale.



Step 5: Open your card and push the fold of the cut square inwards. Your basic square origami cutout is ready.

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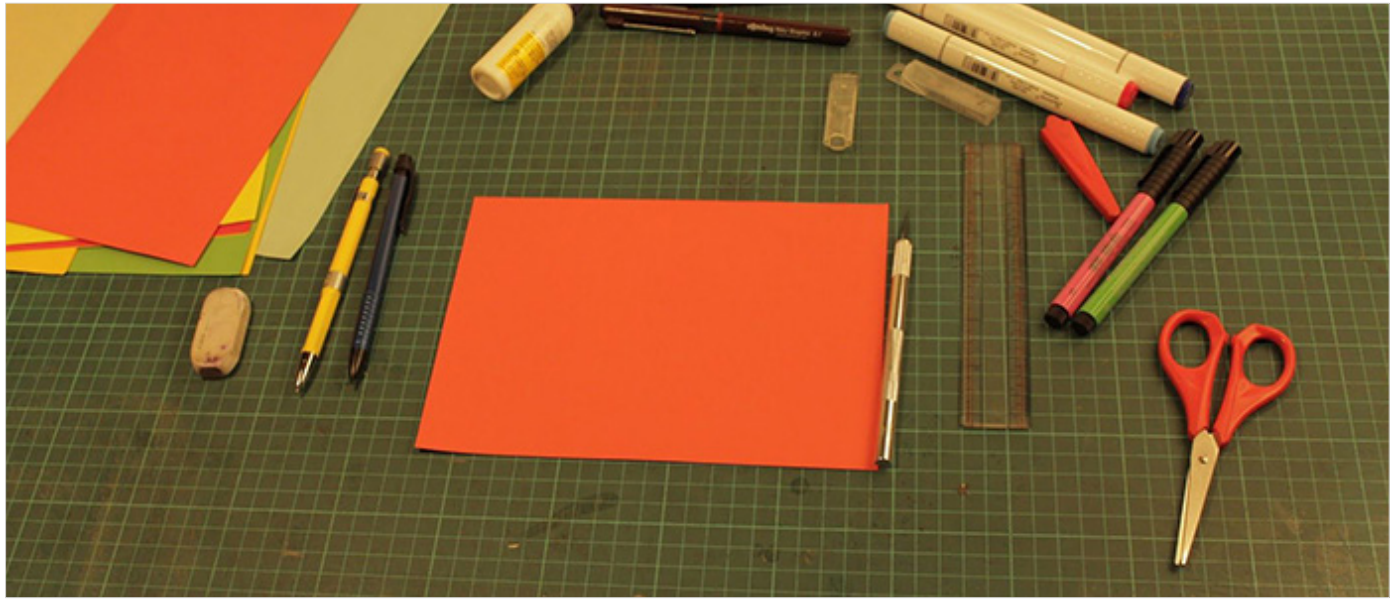
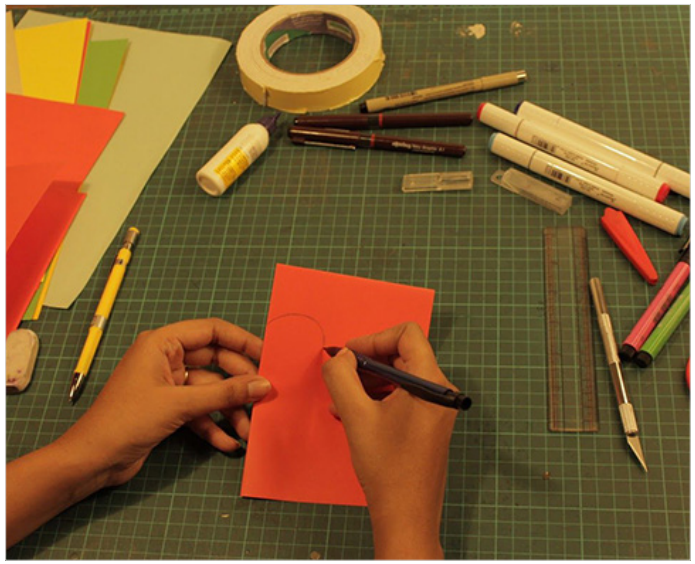
B. Heart

The technique for making heart card is very similar to the previous one.



Step 1: Take any colour tinted or cartridge paper (thickness of more than 130gsm) fold it in half and press it firmly.



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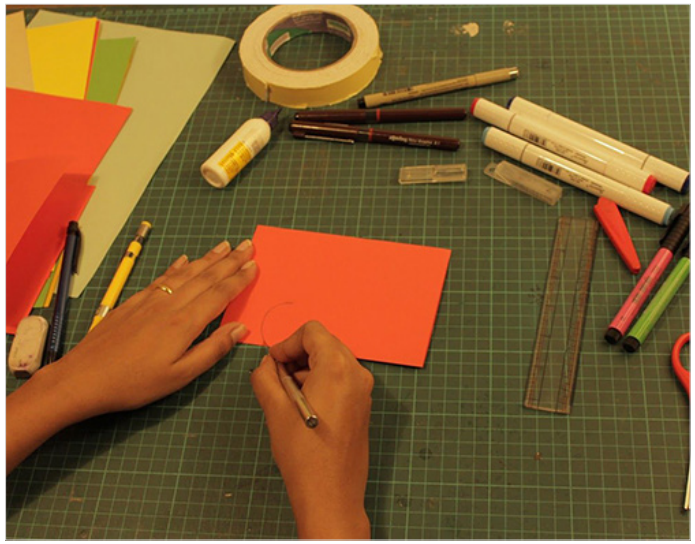
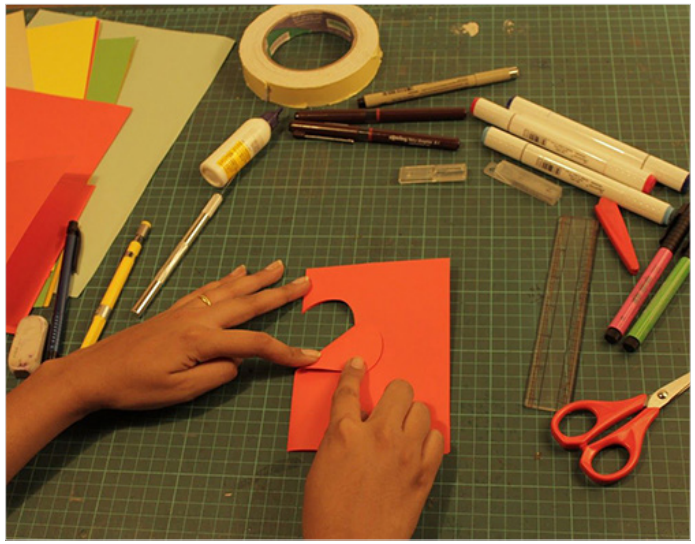
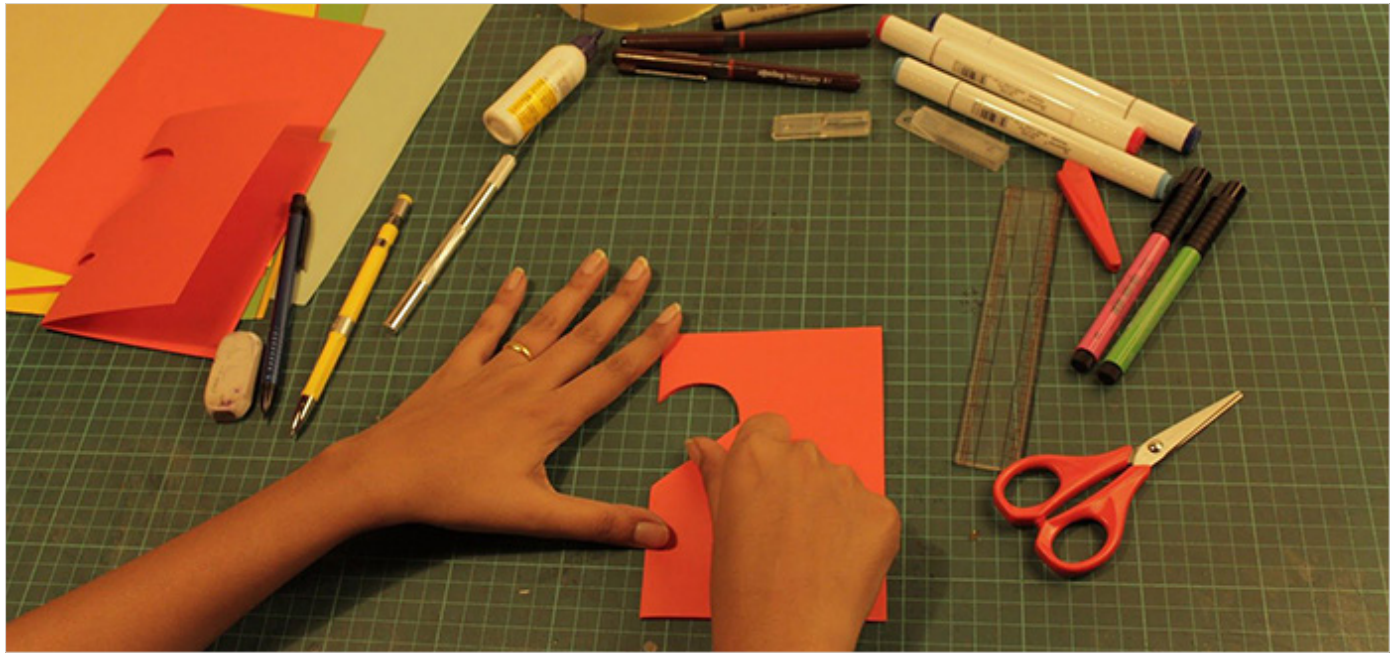


Step 2: Draw half heart shape on one side of the paper.



Step 3: Cut only the top curved portion and fold it as shown.



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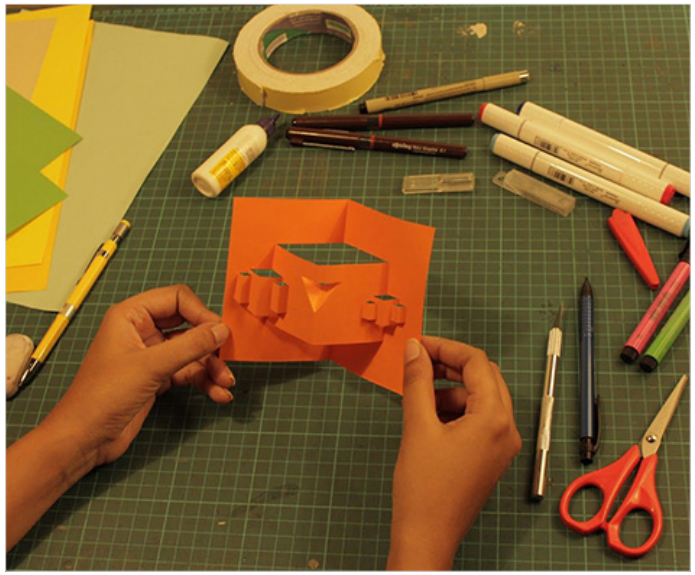
Step 4: Open your card and push the fold of the cut heart inwards. Your heart cutout is ready.

Similarly, you can explore a lot of different cuts and shapes.
Following are a few of explorations that we tried.



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Pop-Up Design

Mechanism Paper Transformation to 3D Sculpture

by
Mugdha Kale
IDC, IIT Bombay

Source:
https://dsource.in/course/pop-design-0/types-pop-design/paper-cutting-and-folding

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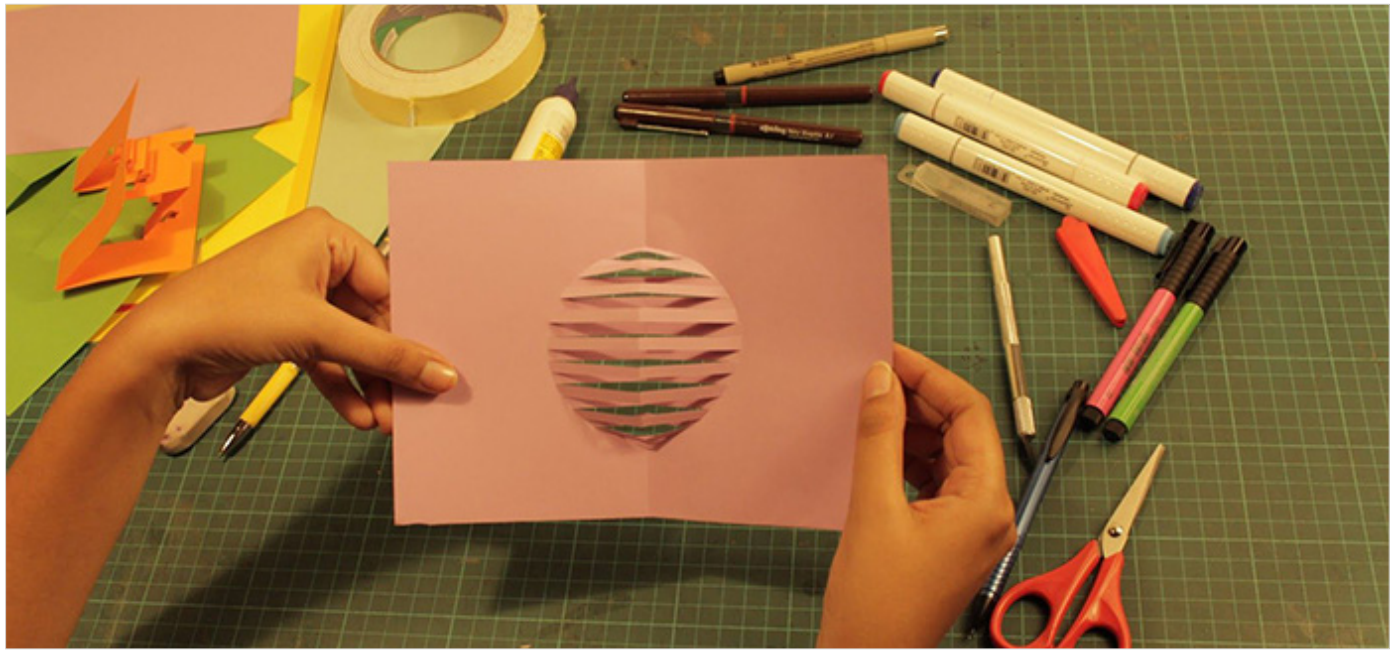

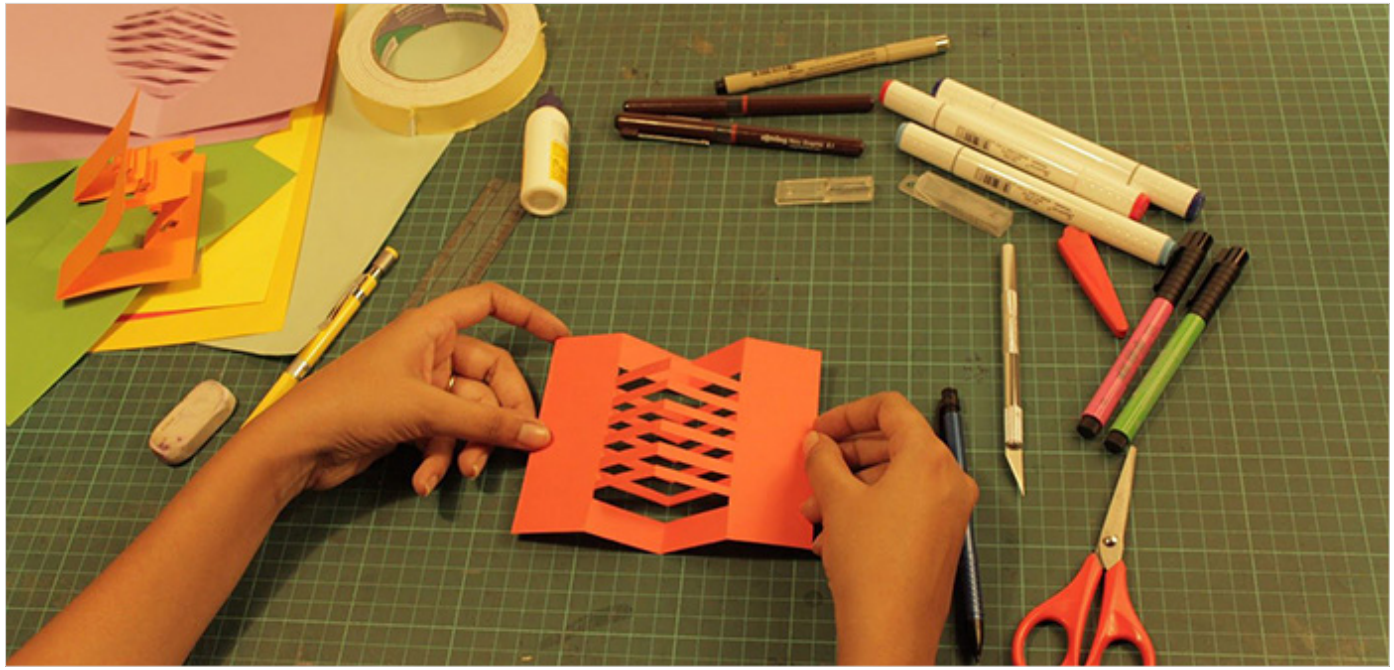

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Mechanism Paper Transformation to 3D Sculpture

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IDC, IIT Bombay

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Paper Pop-ups and Folding

After reading all the history, you must be really excited to start making stuff like this. Well, so were we. In this section, you will find different modules that we tried to create. There was a lot of trial and error but we had a lot of fun and we hope you will too.

Panda Pop-up Card

Penguin

Fox

Owl

Tiger

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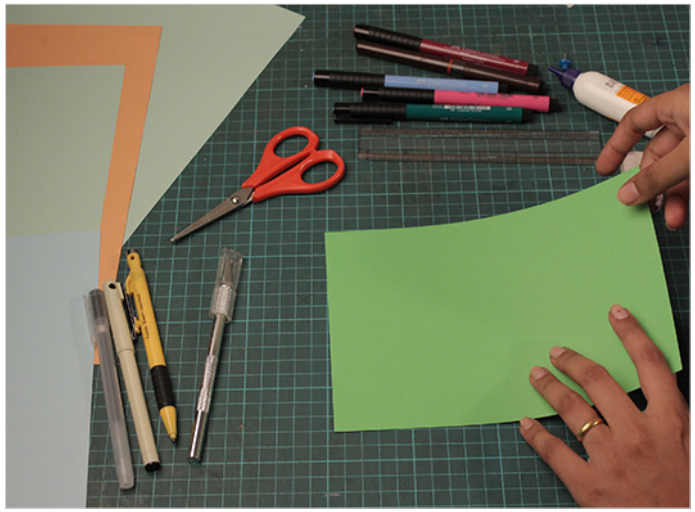
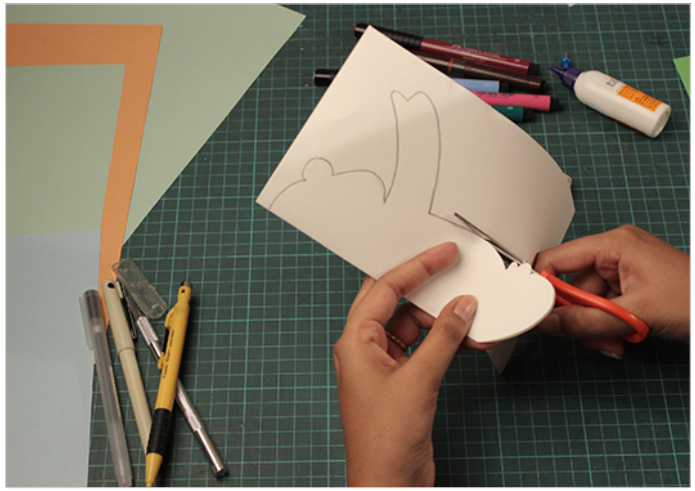
Panda Pop-up Card



Step 1: Take any 2 same size colour tinted paper or cartridge paper, one for outer card and the other for panda pop-up (with a thickness of more than 135-gsm).

Step 2: Fold your outer card paper and one for the panda pop-up in half.

Step 3: After folding, draw the half of basic shape of the panda pop-up as shown.



Step:4: Carefully cut out the outline for the panda along the lines drawn while taking care that the paper on the other side of the fold is cut too.

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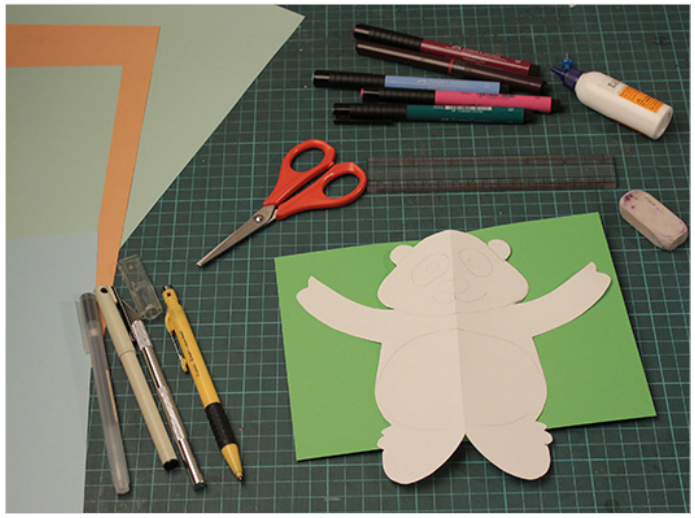
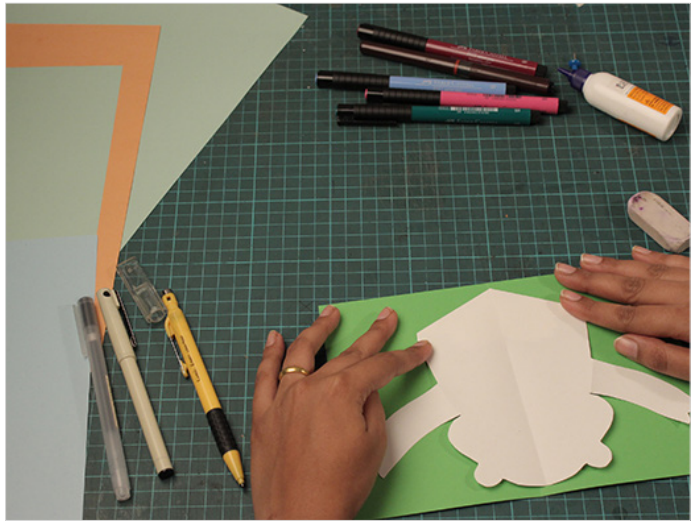


Step 5: Unfold the paper and you will have one piece of panda pop-up.

Step 6: Using a ruler and cutter as a guide, give creases to the legs of the panda cutout.



Step 7: Fold the legs along the crease and apply a small amount of glue as shown.

Step 8: Put that cutout of the panda pop-up in the middle of the fold line of a card (Take care that base pieces with glue are stuck properly). Fold the card in half and crease it. Open the card and ensure that all popping parts are inside the card.

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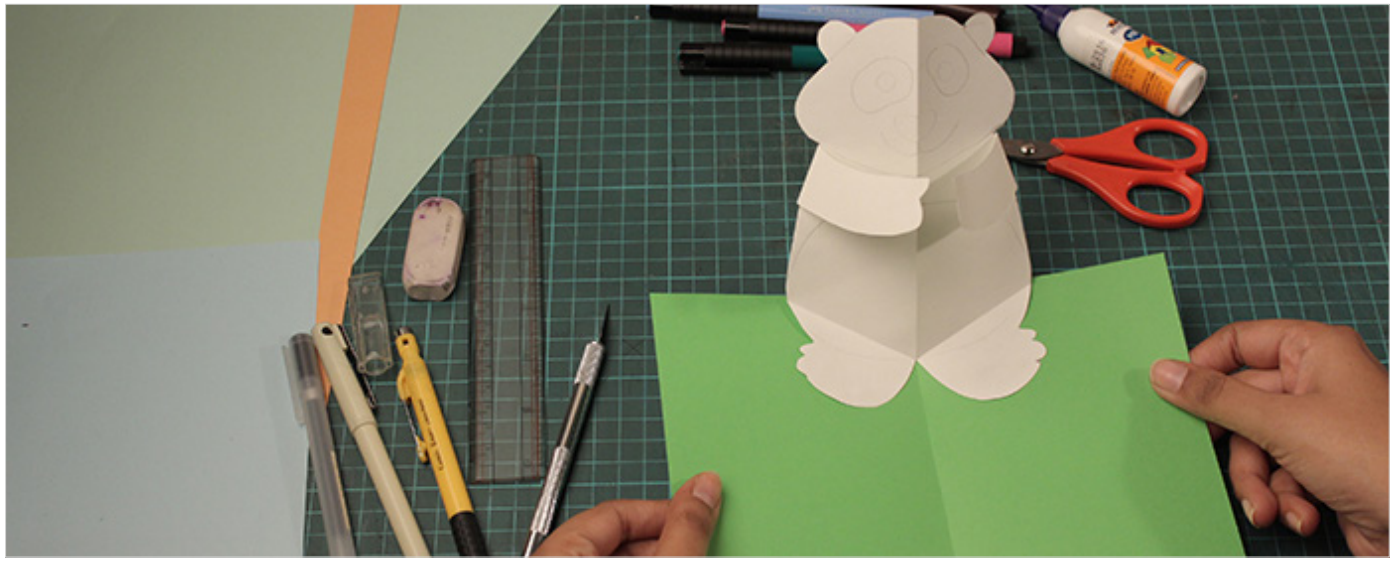

Step 9: Your panda card is ready. Close your card completely and press down firmly.

Step 10: Decorate your panda pop-up card with colours, crayons or markers.

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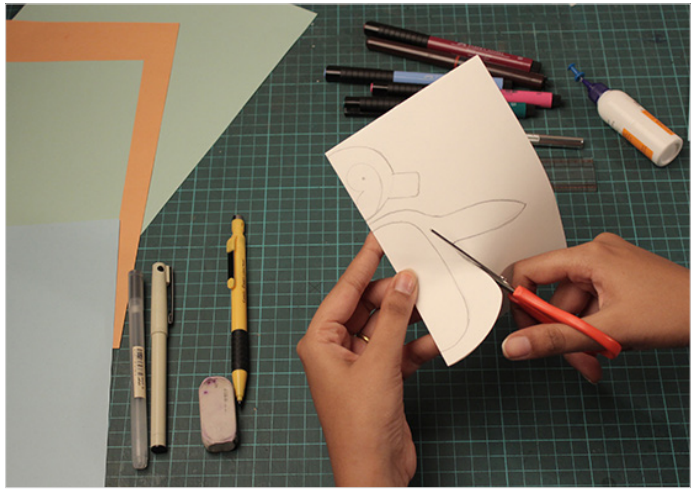
Penguin

Step 1: Take any 2 same size colour tinted paper or cartridge paper for outer card and one for penguin pop-up (with thickness of more than 135-gsm). Also take a smaller card (around one-third the size of outer card for the baby penguin). Fold all the papers in half and press down firmly.

Step 2: After folding paper in half and then draw the basic shape of the penguin as you can see in the picture. Repeat the process for the baby penguin pop-up.



Step 3: Carefully cut out the pop-up pieces for the penguin and its baby.

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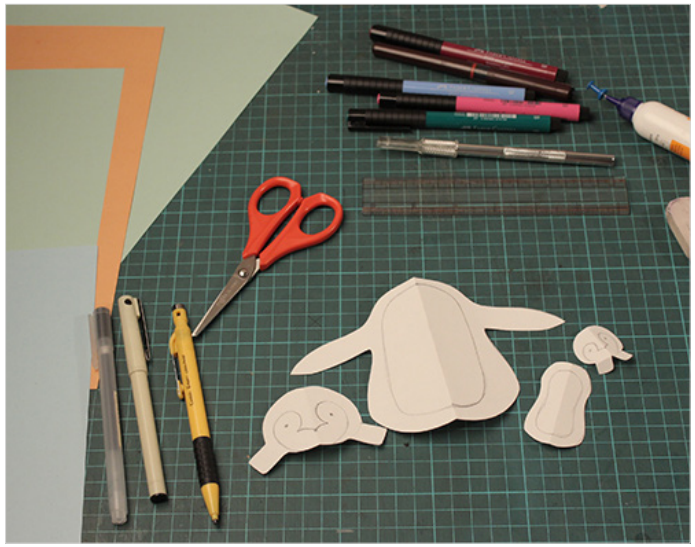
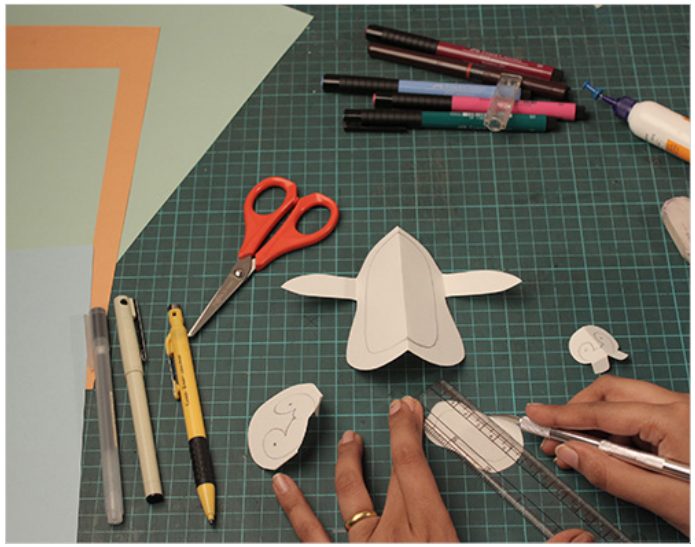
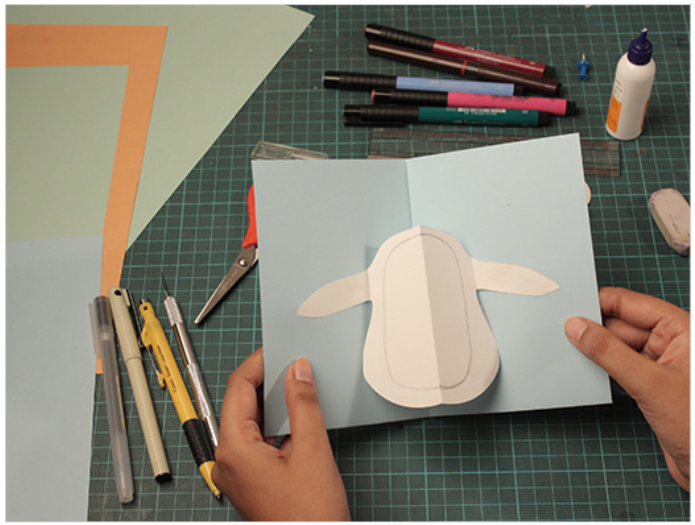


Step 4: You should have 4 pieces in all. Two for adult penguin and the baby each.



Step 5: Using a ruler and cutter as a guide, give the penguin pieces crease and fold.

Step 6: Apply a small amount of glue (only on the wings shown).



Step 7: Make sure the middle line of the card matches the middle line of the penguin's body piece. Press firmly and be sure to let the glue dry.

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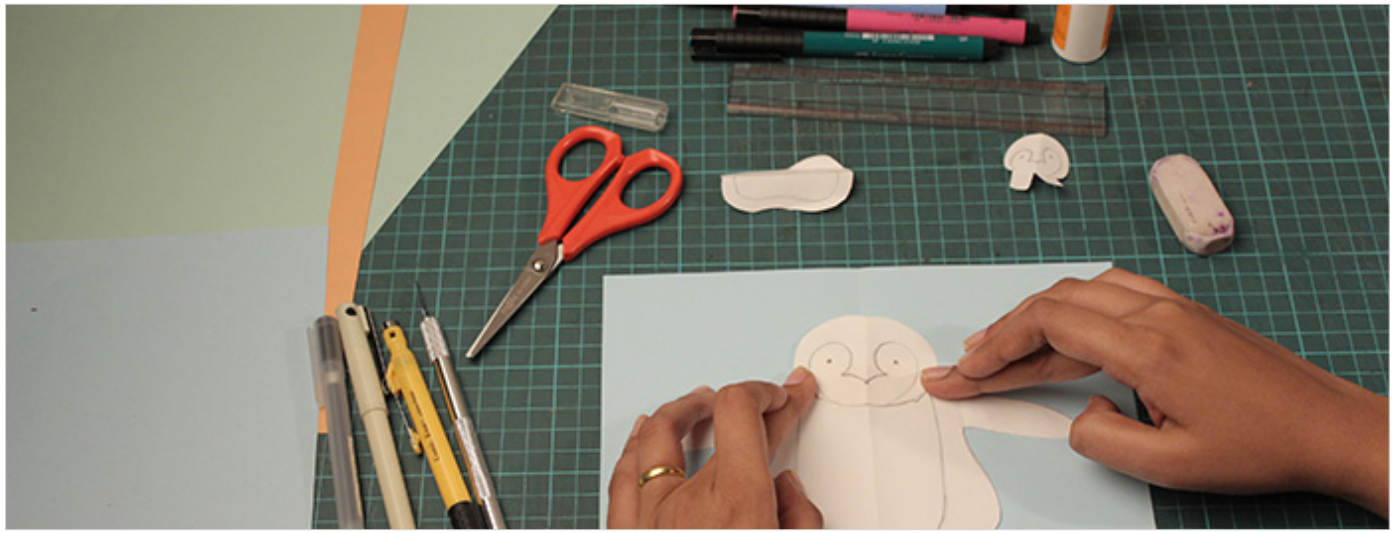
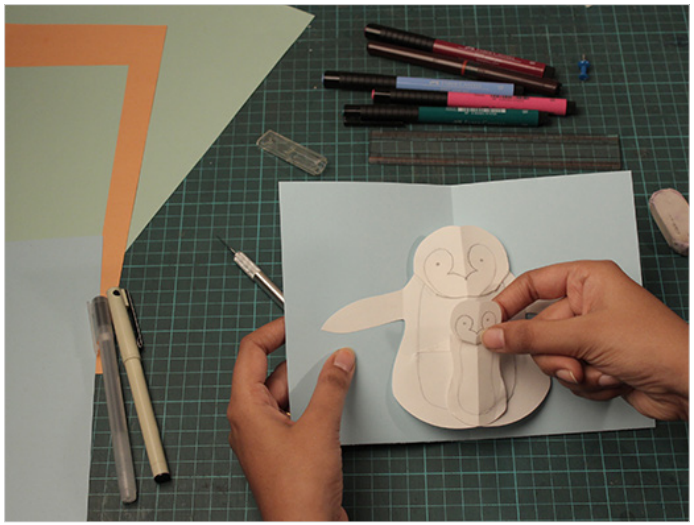


Step 8: Make the headpiece and align it to the body of the penguin. Fold the two tabs at the side of the head-pieces and fold them inwards and apply glue only on the tabs. Make sure the middle line of the card matches the middle line of the headpiece. Press firmly and let the glue dry.

Step 9: Repeat 6 steps for the baby penguin. Make sure the crease is aligned.



Step 10: Attach the headpiece (similar to step 7)

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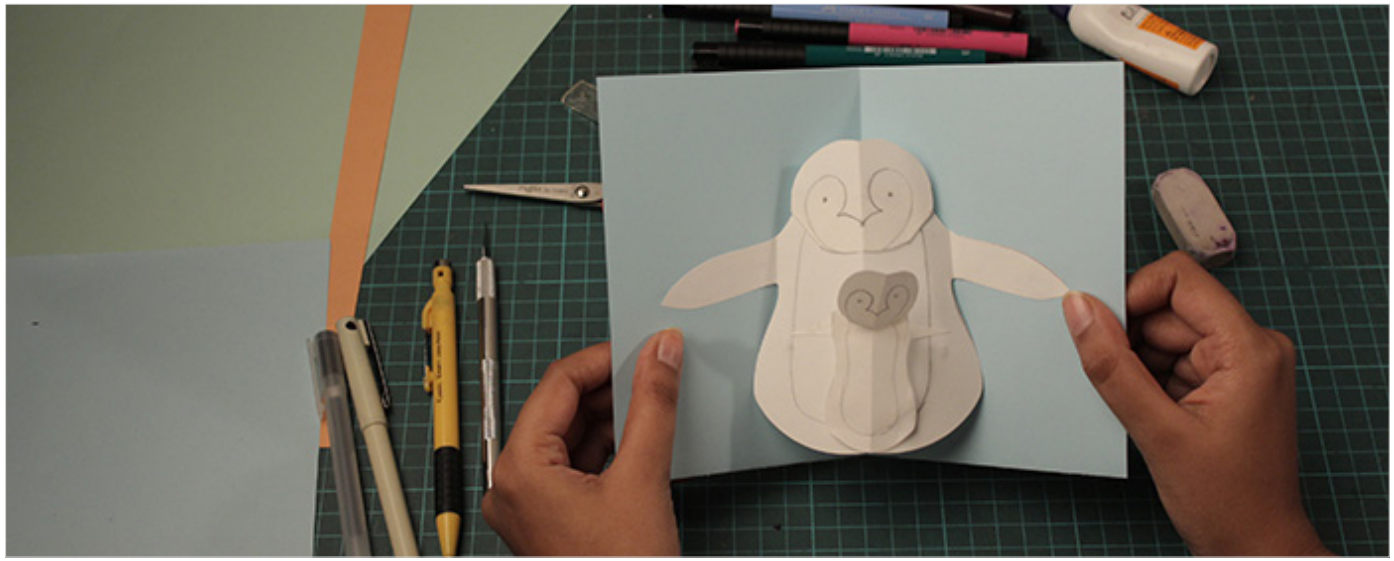

Step 11: Make sure all the pieces are completely dry before closing. Close your card completely and press down firmly.

Step 12: Add colours.

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Fox

Step 1: Take any 2 same size colour tinted paper or cartridge paper, one for outer card and the other for the fox pop-up (with thickness of more than 135-gsm).

Step 2: Fold the paper (for outer card) in half and press down firmly.

Step 3: Fold the paper (for the fox) in half and draw the basic shape of the half fox as you can see in the picture.

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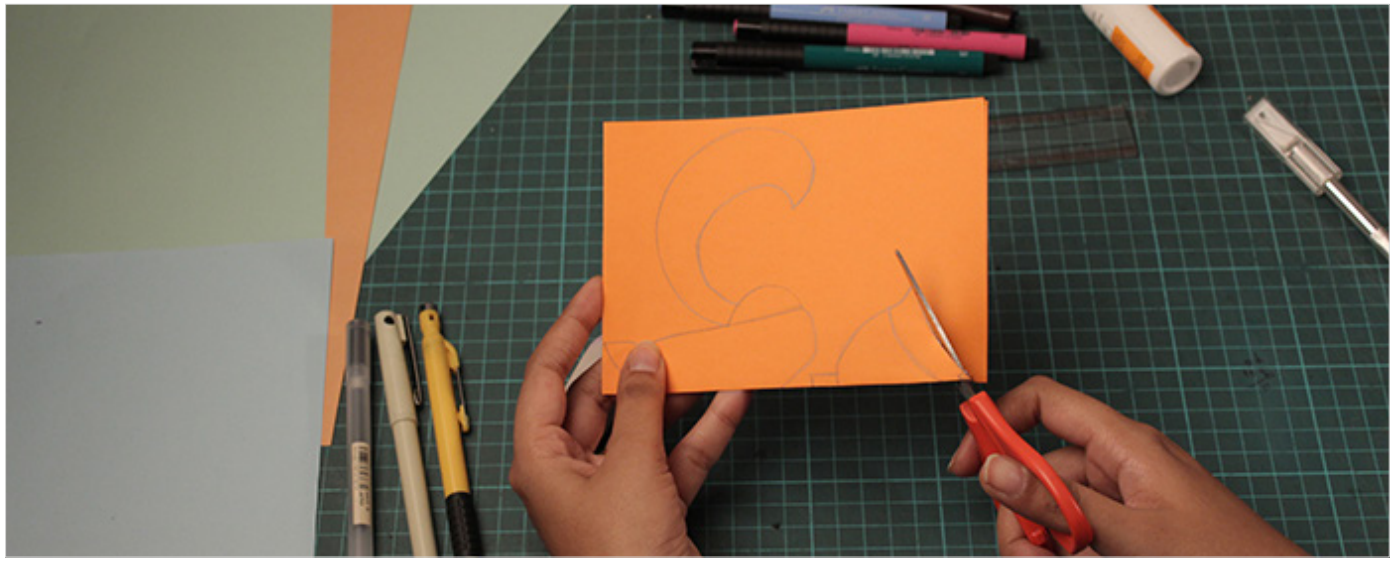

Step 4: Cut out the pieces with the use of scissors or paper cutter.

Step 5: Make sure you will have 3 pieces of fox pop-up.

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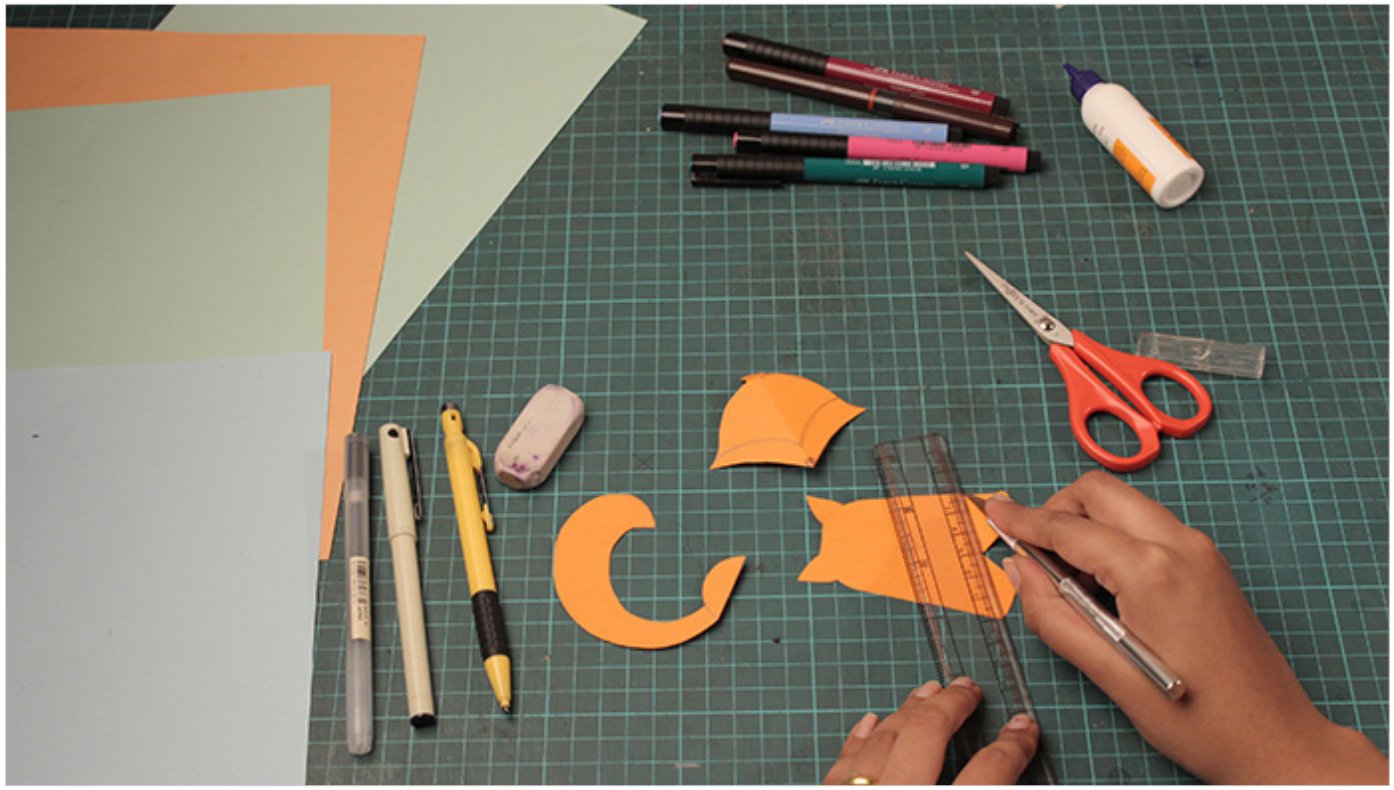

Step 6: Understand the fold carefully. Fold your main fox pop-up piece in half. Using a ruler as a guide, fold the fox popup pieces carefully.

Step 7: Make sure you will put all the pieces on the basic middle fold line. In this picture, we are using basic v fold. Use a very small amount of glue to stick (apply glue only on the base tabs of the body).

Step 8: Stick the fox popup head in the middle of the fox body fold by folding and glueing the tab provided on the top. Make sure your pieces after pasting will not go out of the card.

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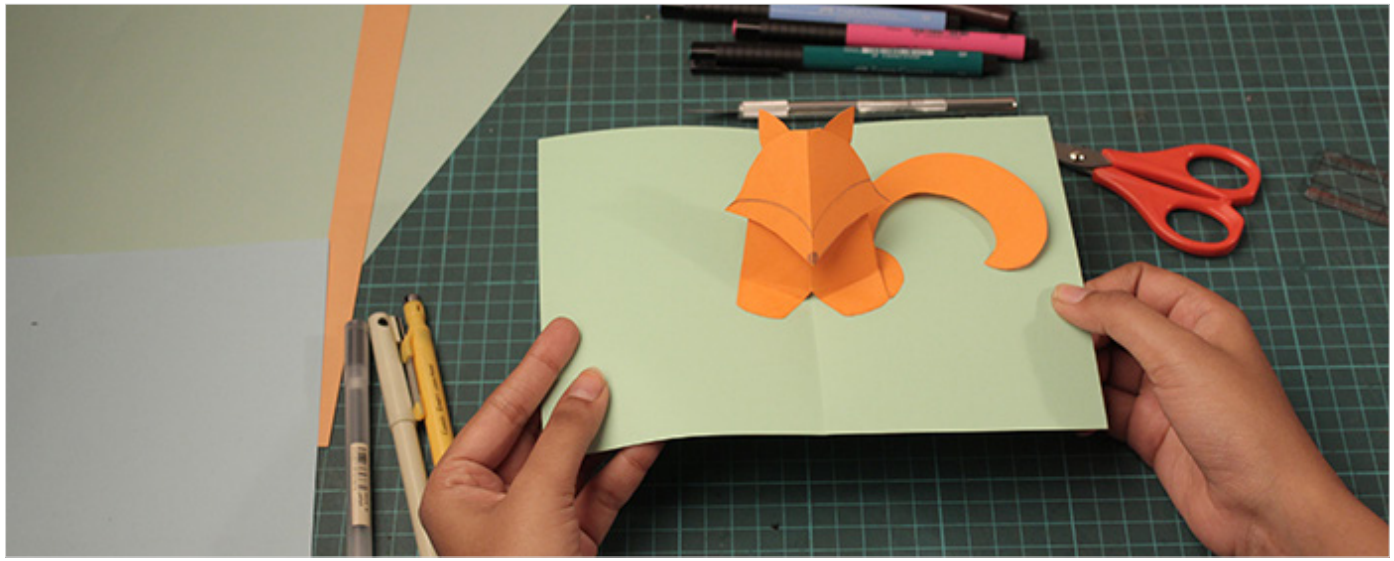

Step 9: Stick the tail behind the fox pop-up body.

Step 10: Your Basic structure of the fox is ready. You can decorate it with the use of coloured pens or any other art material.

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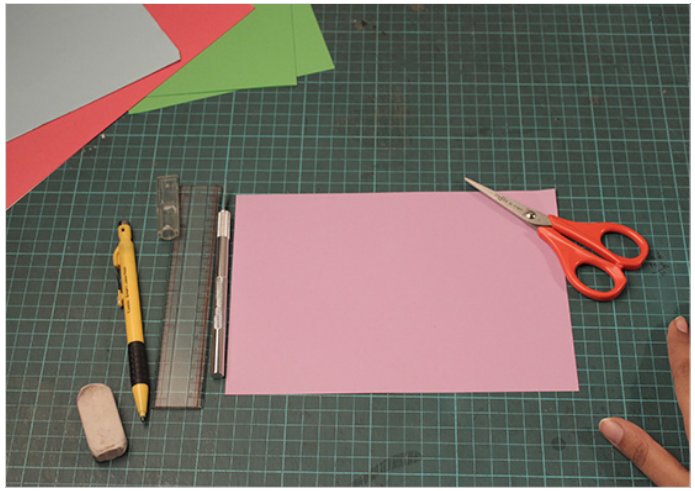
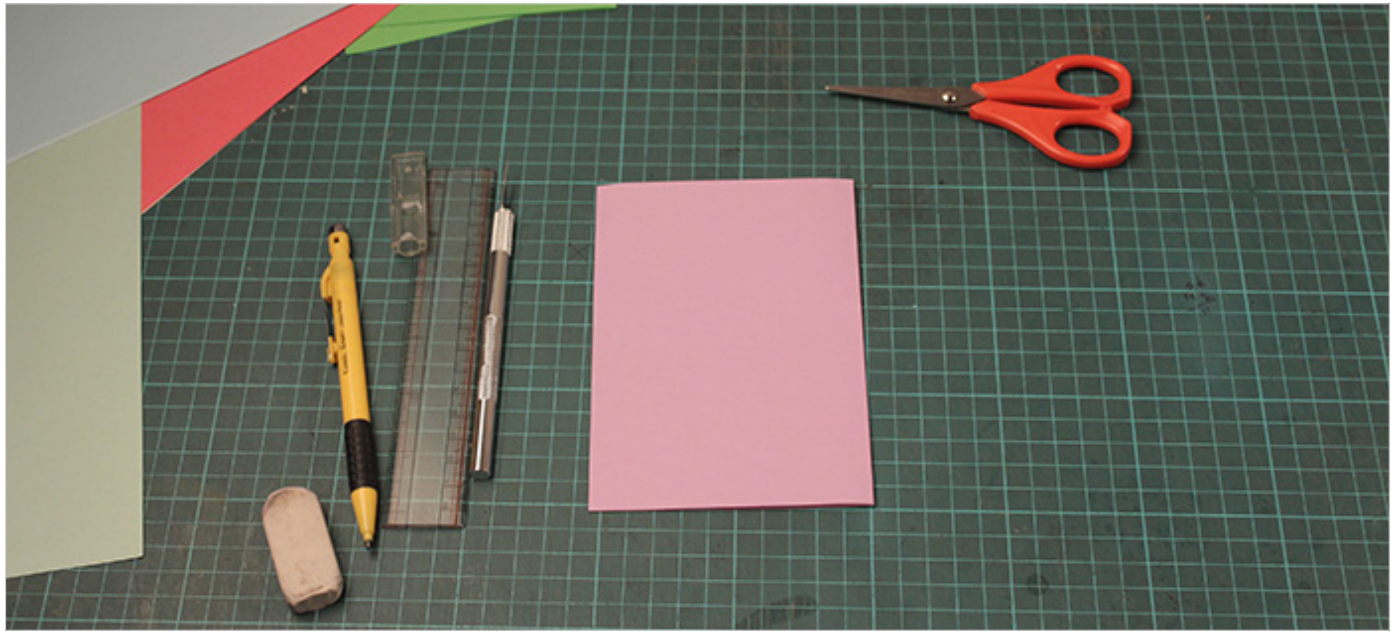
Owl



Step 1: Take any 2 same size colour tinted paper or cartridge paper, one for outer card and the other for the owl pop-up (with thickness of more than 135-gsm).

Step 2: Fold the paper (for outer card) in half and press it firmly with the use of a thumb or scale.



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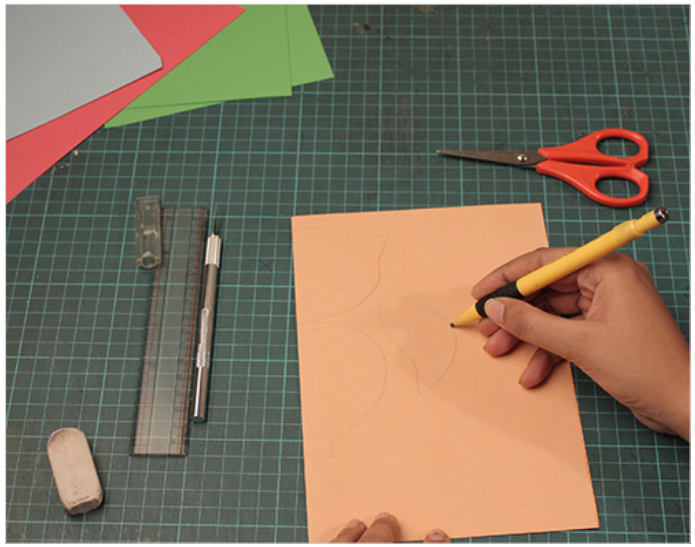
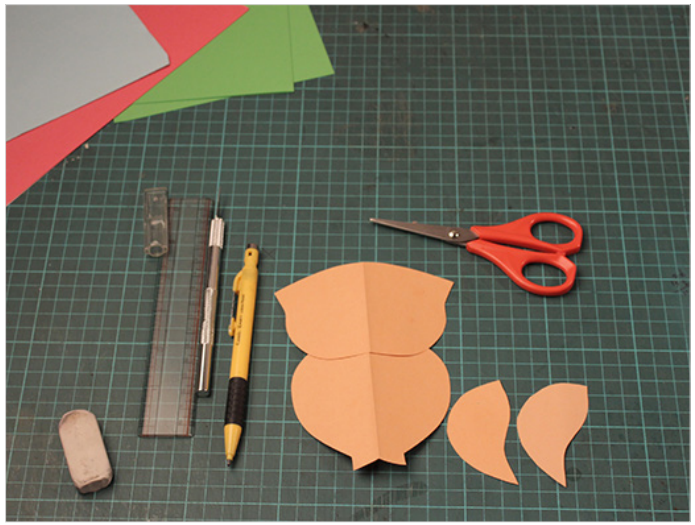
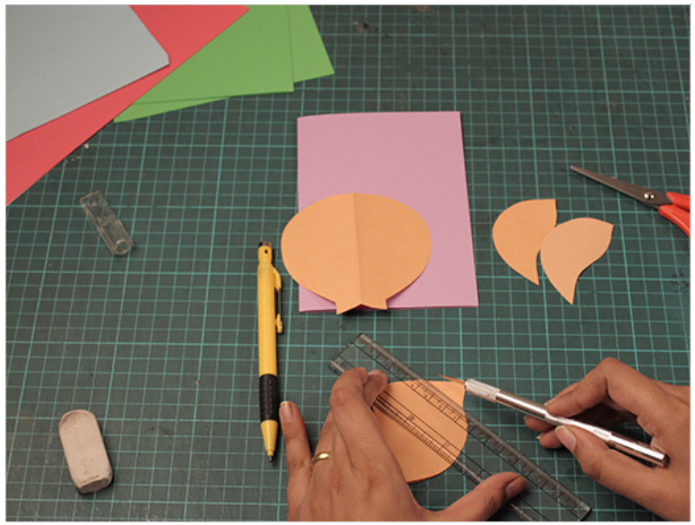


Step 3: Fold the paper (for the owl) in half and then draw the basic shape of a half-side owl pop-up.

Step 4: Carefully cut out your owl pop-up pieces.



Step 5: You should have 4 pieces in all including the owl-shaped card.



Step 6: Understand the fold carefully. Fold your main owl pop-up piece in half. Using a ruler as a guide crease it and then fold the owl popup pieces carefully.

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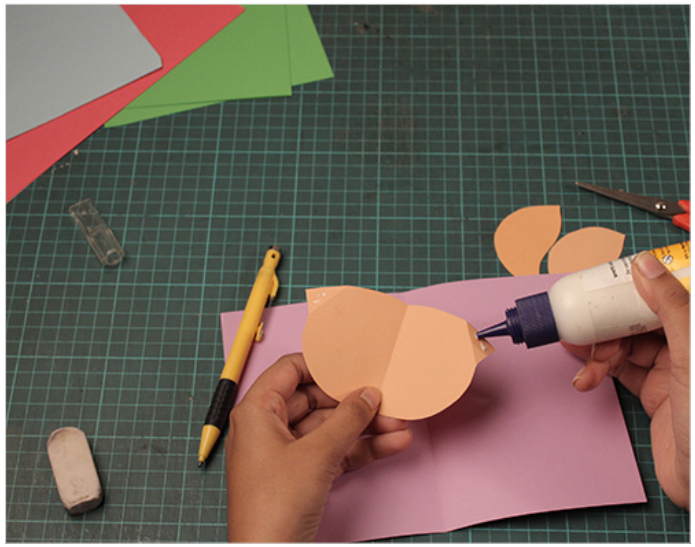
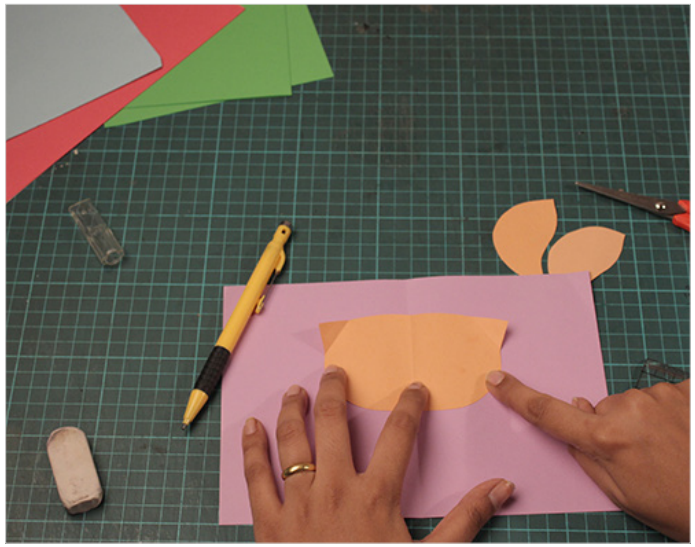
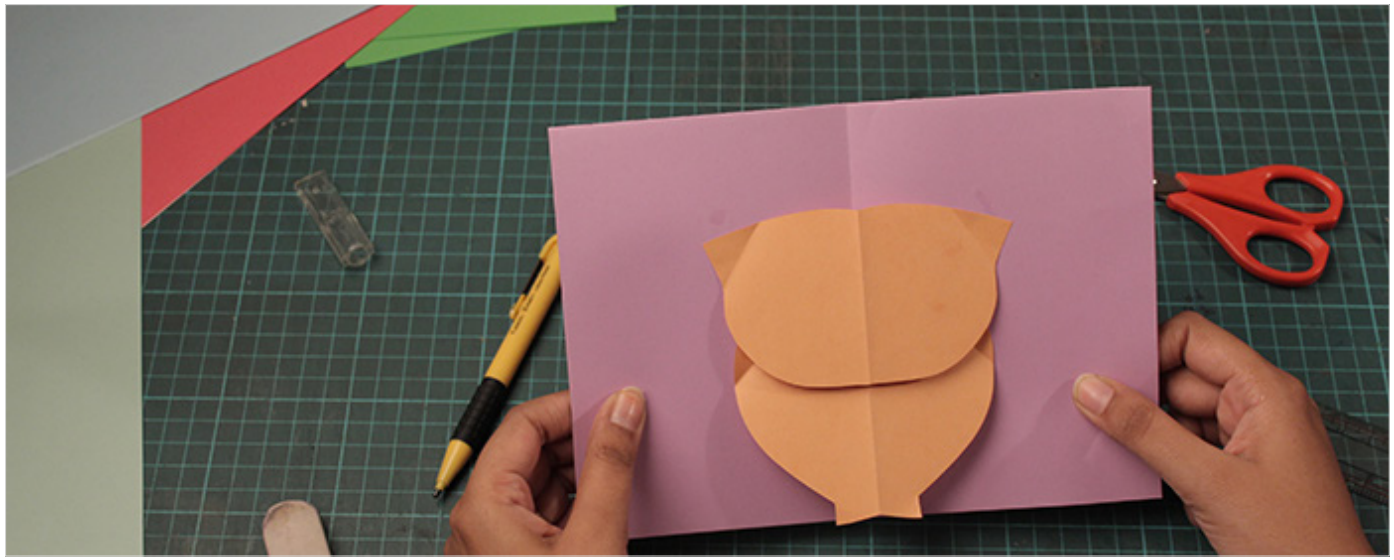


Step 7: Apply a small amount of glue (only on the tabs as shown).



Step 8: Make sure you align the piece of owl pop-up in the centre of the paper fold line while sticking.



Step 9: Make the headpiece of the owl and align it to the body of the owl pop-up. Make sure the middle line of the card matches the middle line of the headpiece. Press firmly and let the glue dry.

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Pop-Up Design

Mechanism Paper Transformation to 3D Sculpture

by
Mugdha Kale
IDC, IIT Bombay

Source:
https://dsource.in/course/pop-design-0/types-pop-design/paper-pop-ups-and-folding/owl

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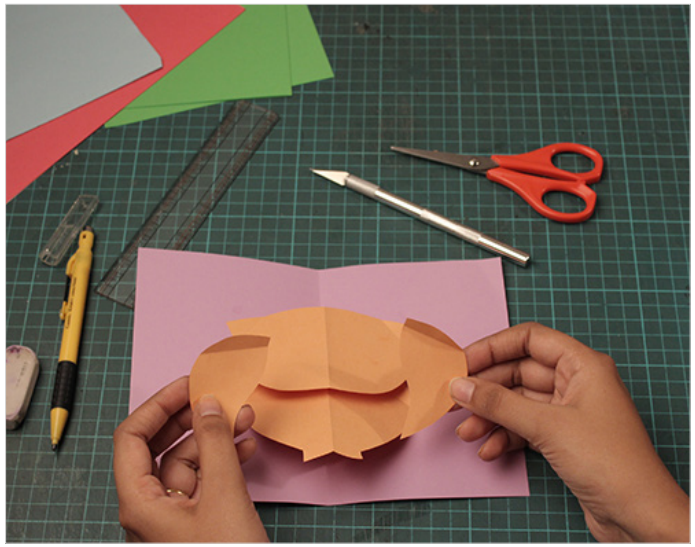
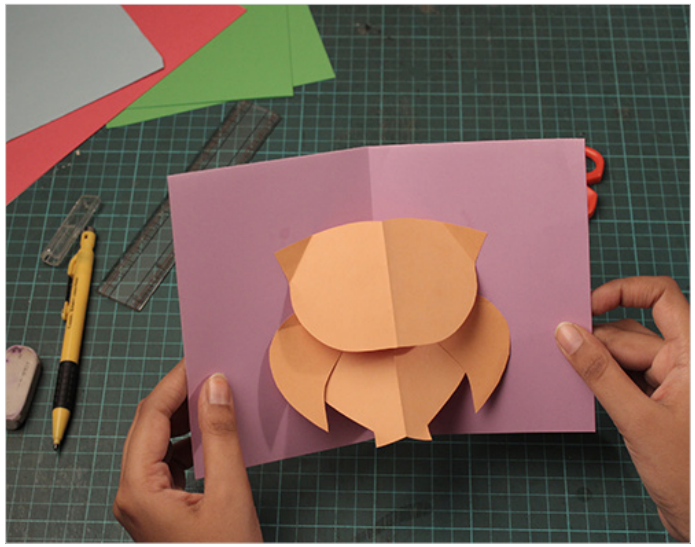


Step 10: Stick the owl wings carefully.



Step 11: Make sure all the pieces are completely dry before closing. Close your card completely and press down firmly.

Step 12: Decorate the owl pop-up with colours.

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https://dsource.in/course/pop-design-0/types-pop-design/paper-pop-ups-and-folding/tiger

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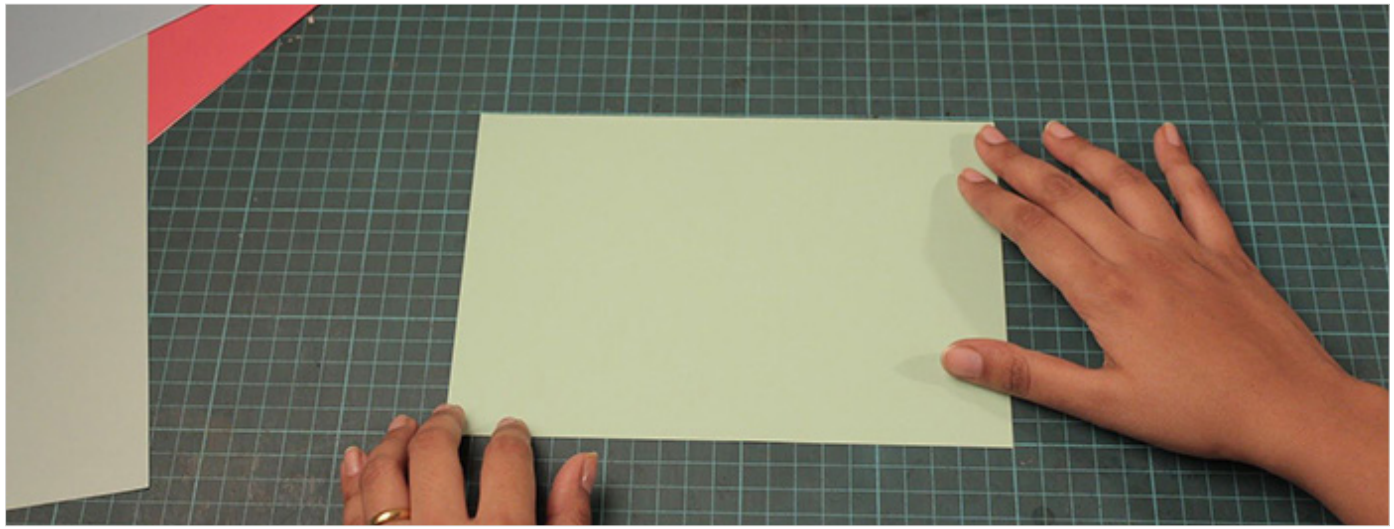
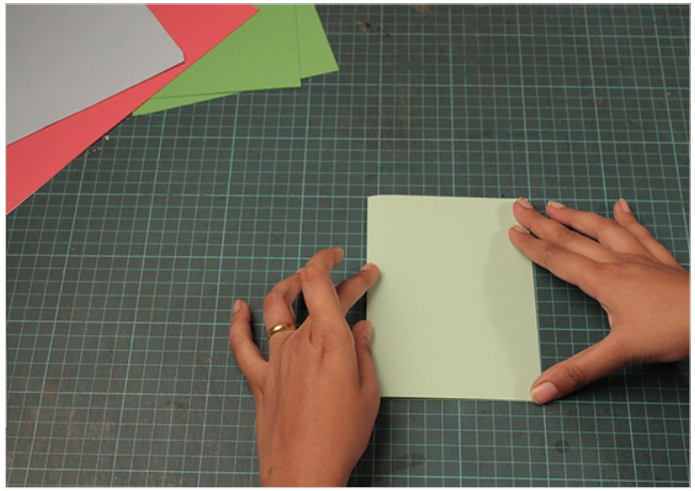
Tiger



Step 1: Take any 2 same size colour tinted paper or cartridge paper, one for outer card and the other for the tiger pop-up (with thickness of more than 135-gsm).



Step 2: Fold it in half and press firmly.

Step 3: Fold the paper in half and draw half basic shape of tiger popup.

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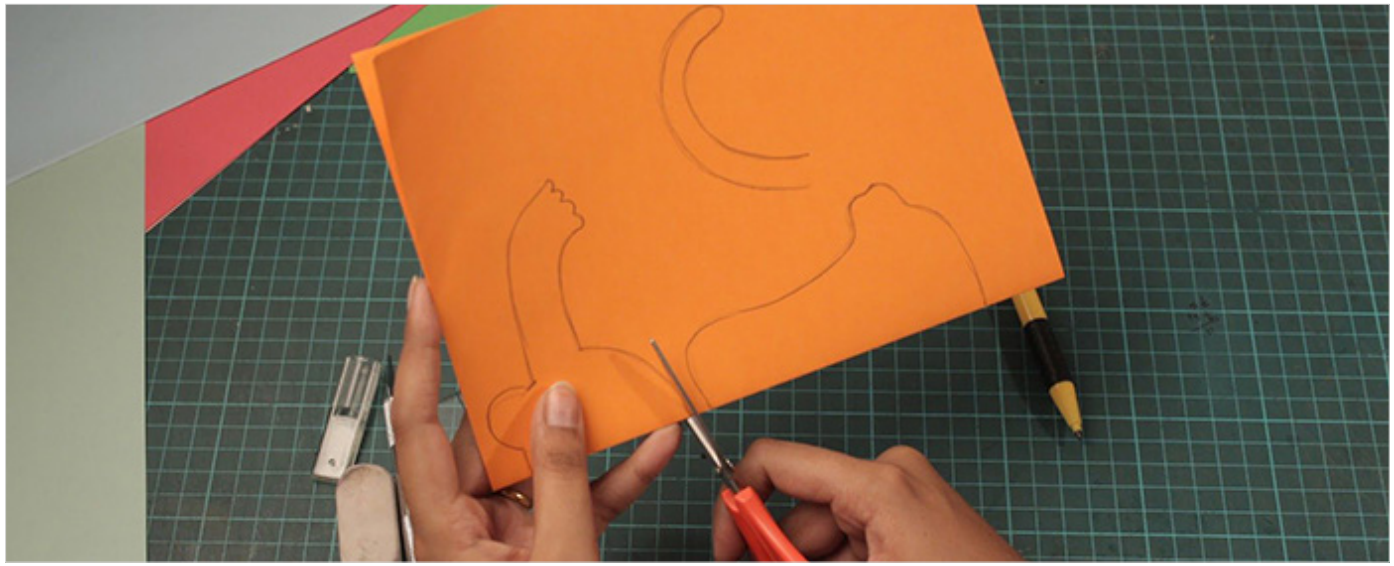
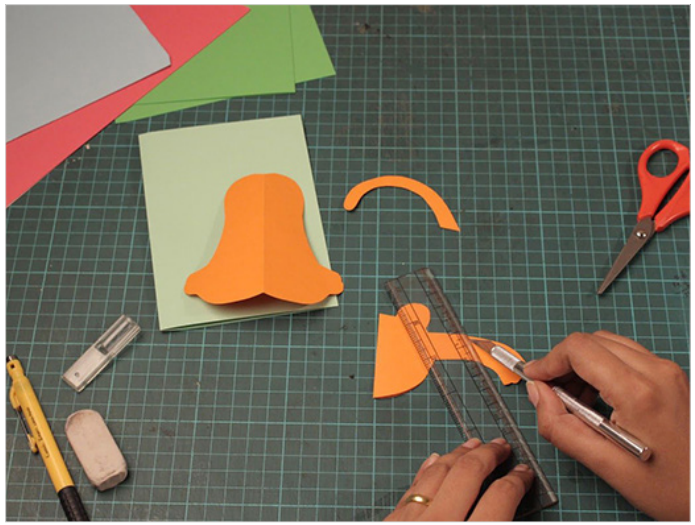


Step 4: Carefully cut out all the tiger pieces.

Step 5: You should have 3 pieces of tiger popup.



Step 6: Using a ruler and cutter as a guide, give the tiger pieces crease and fold.

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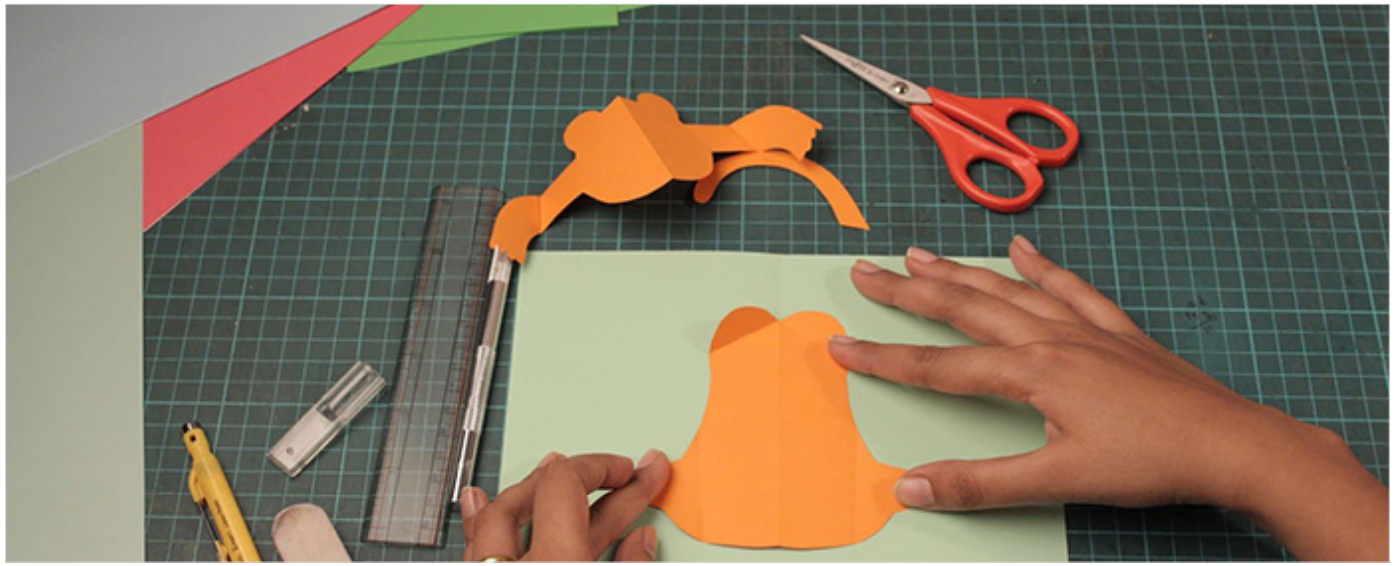

Step 7: Make sure the middle line of the card matches the middle line of the tiger's body piece. Apply a small amount of glue (only on the smaller folds) and press firmly and be sure to let the glue dry.

Step 8: Make the headpiece and align to the body of the tiger. Make sure the middle line of the card matches the middle line of the headpiece. Press firmly and let the glue dry.

Step 9: Your tiger pop-up card is ready. Add colours to it.

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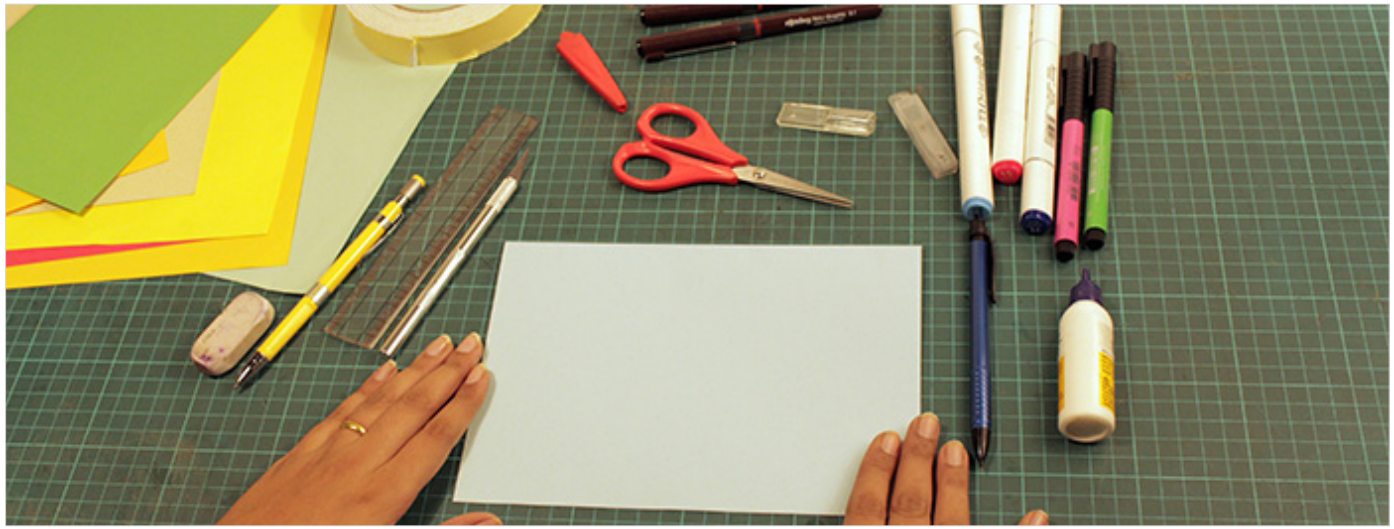
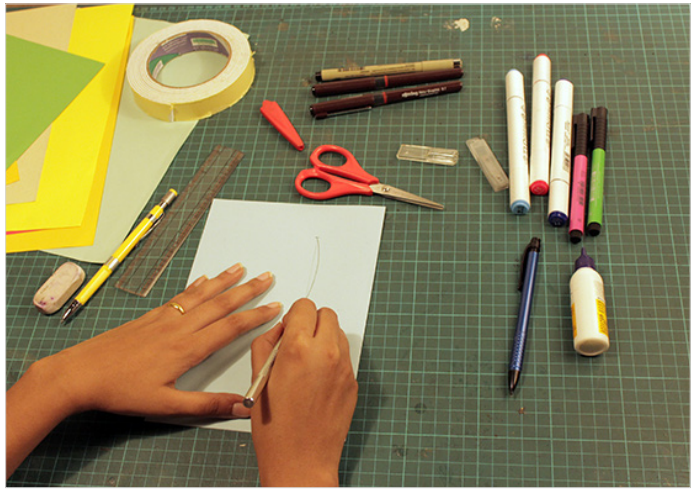
Paper Surface Mobility and Folding



Step 1: Take any two-color tinted paper (with thickness of more than 200 gsm). One for the top and one for the base.

Step 2: Leave 1 inch space from both the sides of paper and then draw one wavy line.



Step 3: With the use of cutter cut the wavy line part with 1mm thickness and stick another same-size blank paper on the back side.

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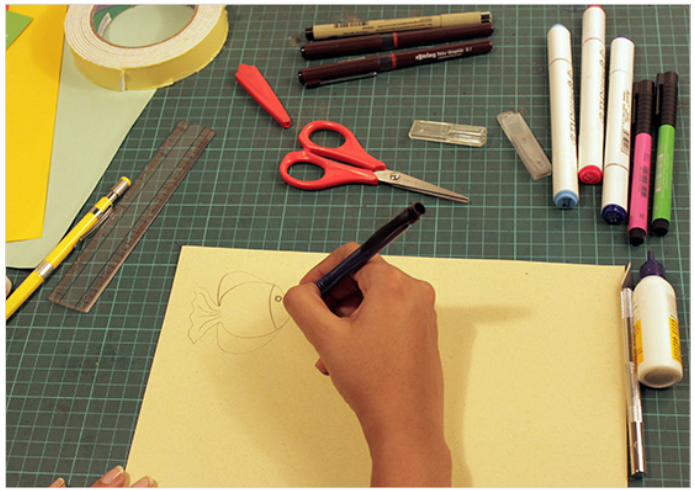
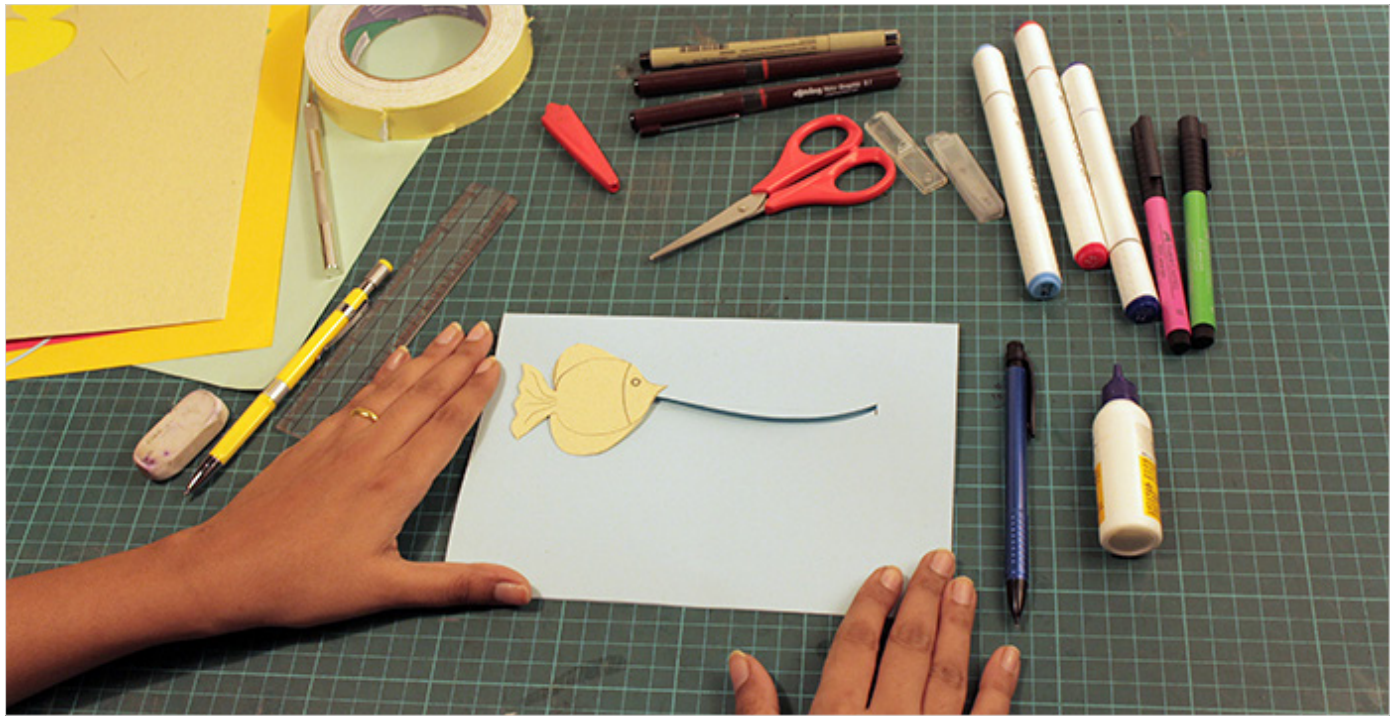


Step 4: Draw the basic shape of the fish on paper (more than 200 gsm thickness).

Step 5: With the use of cutter or scissor cut it carefully.



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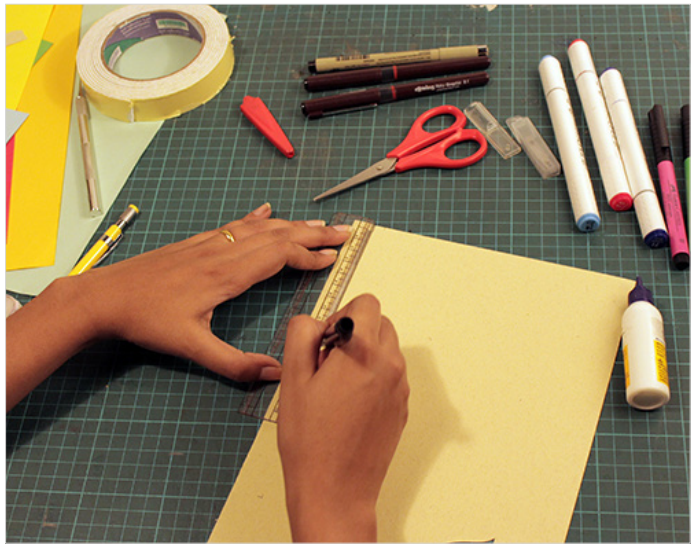
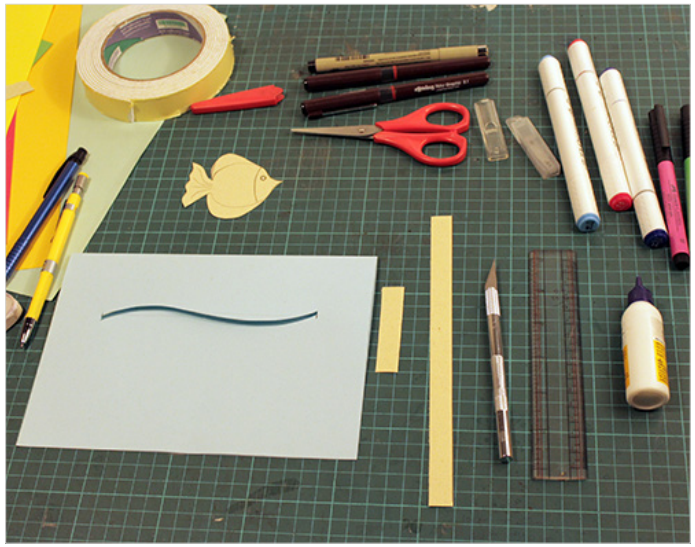
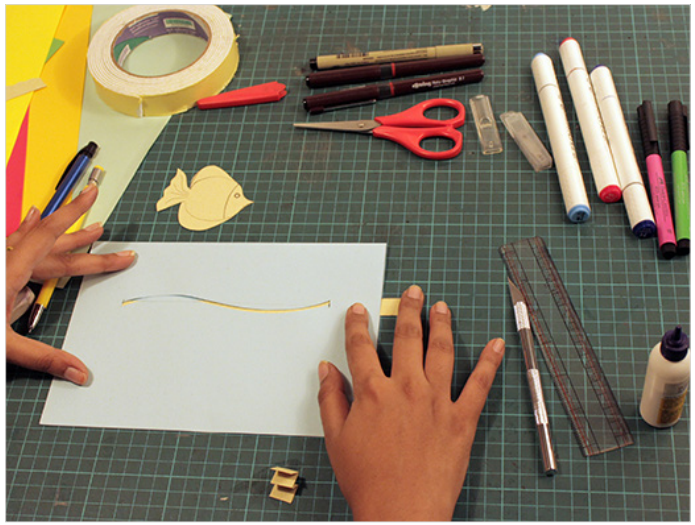


Step 6: With the use of scale and cutter cut 1 cm thickness paper cut out for pull tabs.



Step 7: You will have 2 pieces as you can see in the picture for pull-up tabs.

Step 8: Take a small piece of paper, tab and fold it in the shape of M as you can see in the picture.



Step 9: Keep that longer pull tab under the wave cut-out.

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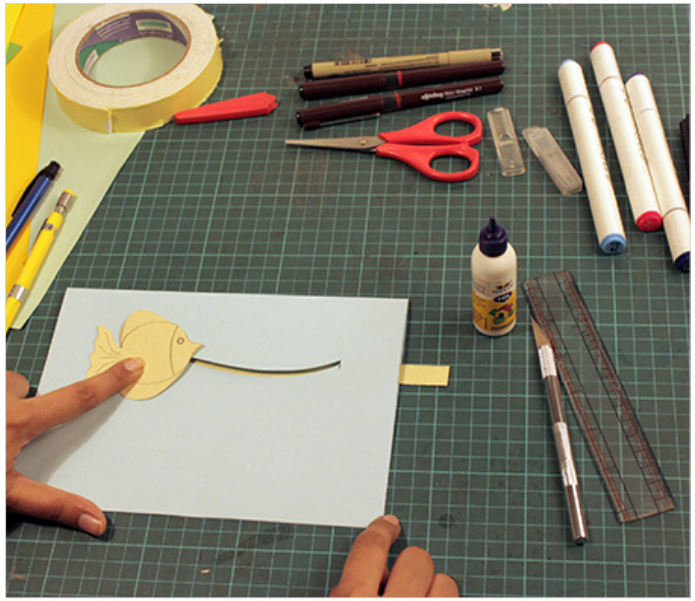
Step 10: Apply a small amount of glue on both sides of the M fold tab. After applying glue on both the sides keep one fold inside, stick it properly and another one on the cutout shape of the fish. Make sure both the parts stick properly and firmly without sticking any other object.



Step 11: Try to pull the tab and make a movement.

Step 12: Add colour and play with the pulling tab mechanism.

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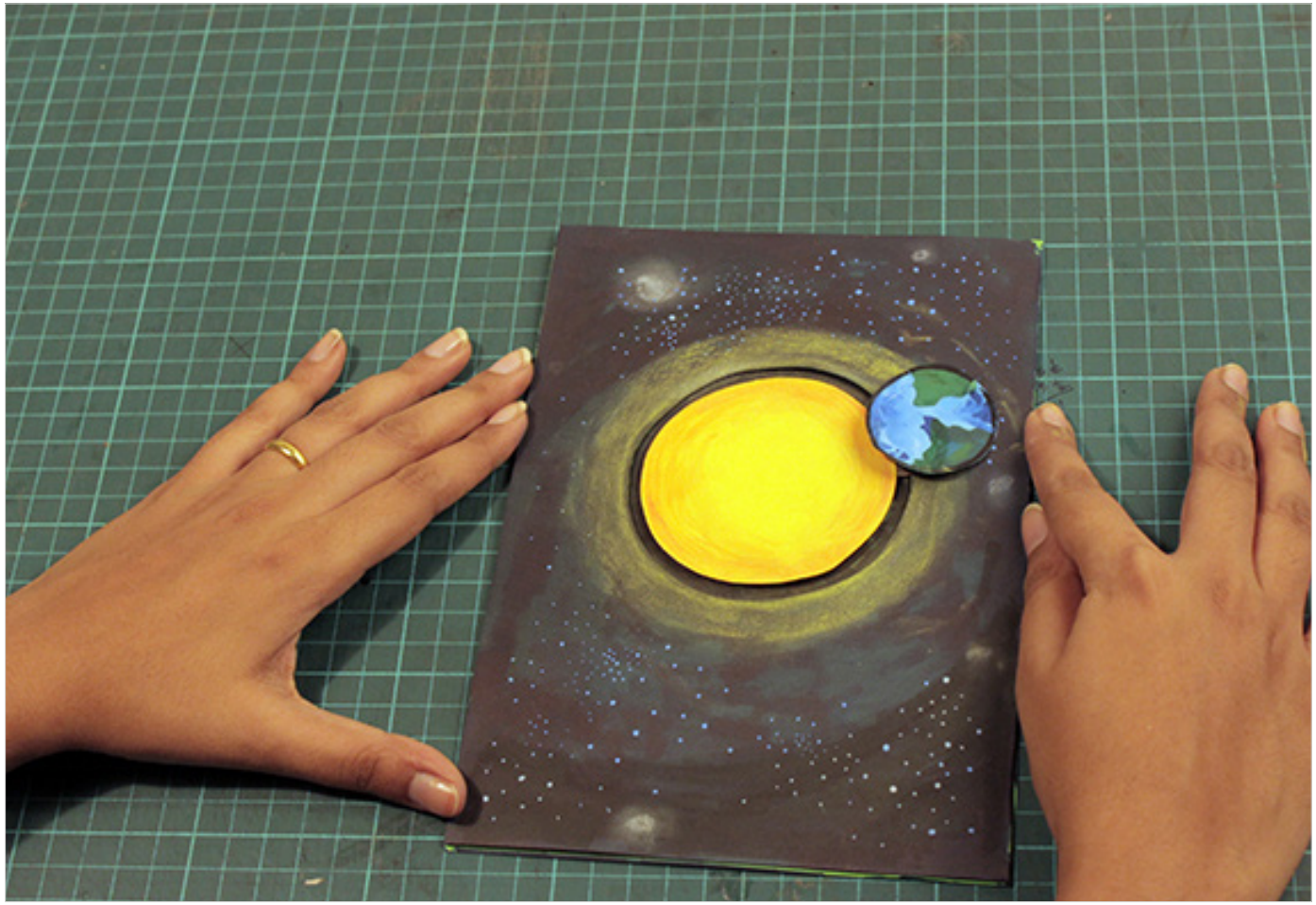
Within mobility and surface mechanism, we have tried few interactive methods where you can teach kids different methods in a unique way.

For example: In one video we have tried solar system relation of planet earth and sun and how earth rotates around the sun.



In the second video we have taken taken very famous story from Panchatantra "Talkative Tortoise".

With the use of this method, you can add interactions in many stories and concepts to generate interest.

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Reference

- http://www.popuplady.com/about02-timeline.shtml
- https://blog.bookstellyouwhy.com/a-brief-history-of-the-pop-up-book
- https://www.slideshare.net/catalinaoleon/pop-up-design-and-paper-mechanics
- https://blog.bookstellyouwhy.com/a-brief-history-of-the-pop-up-book

Reference Videos:

- History of pop up
http://www.marthastewart.com/918284/history-and-art-pop-book
- An example of use of pop up for teaching
https://www.youtube.com/watch?v=p-vNSqUy0l4
- An example of a pop up encyclopedia
https://www.youtube.com/watch?v=rLr2vMC9Tjc

Pop up Tutorials

- http://wp.robertsabuda.com/make-your-own-pop-ups/
- https://www.youtube.com/watch?v=RZR_b753ZJ0

Reference Books

- Typographical popup book ABC3D by Marion Bataille & documented by bam_books on Instagram
https://www.instagram.com/p/BT8InloFBUS/
- Typographical popup by 10 by Marion Bataille documented by bam_books on Instagram
https://www.instagram.com/p/BT0m2U6l9ZY/

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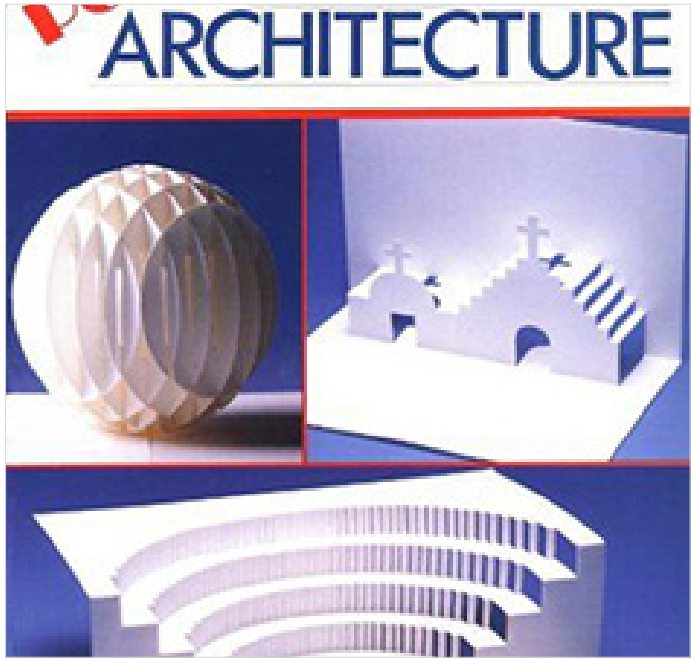

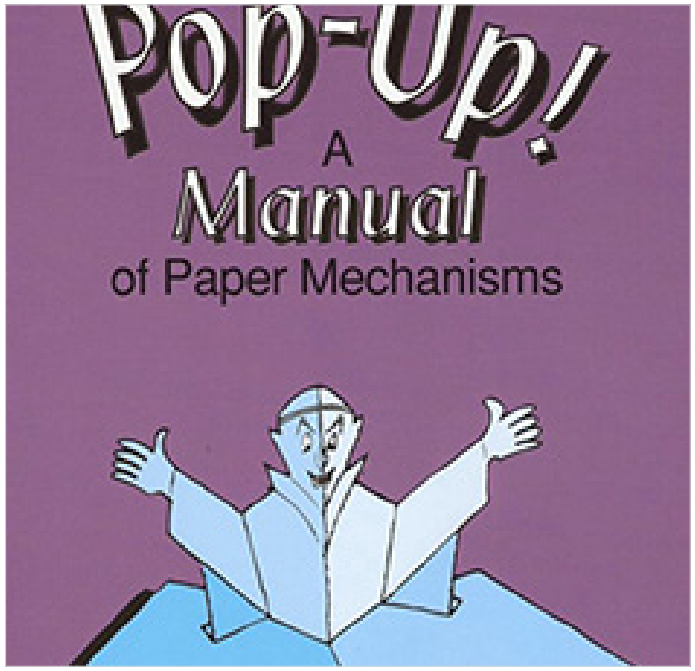

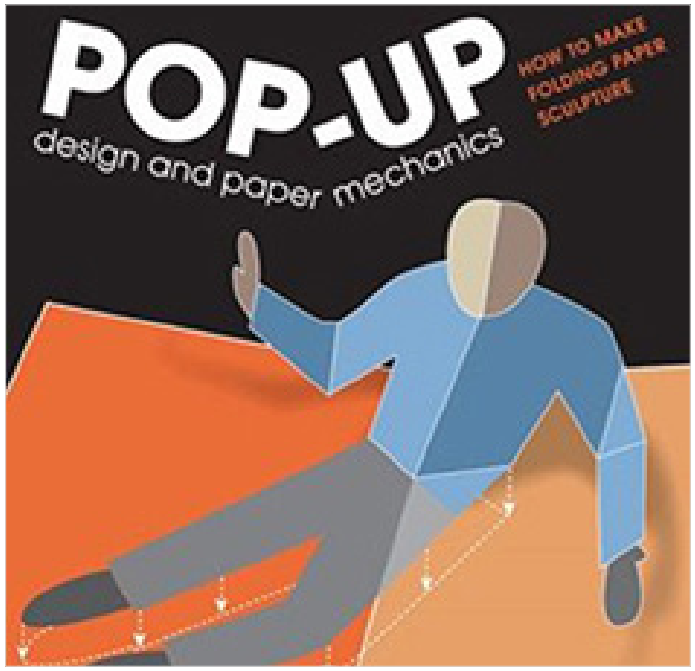

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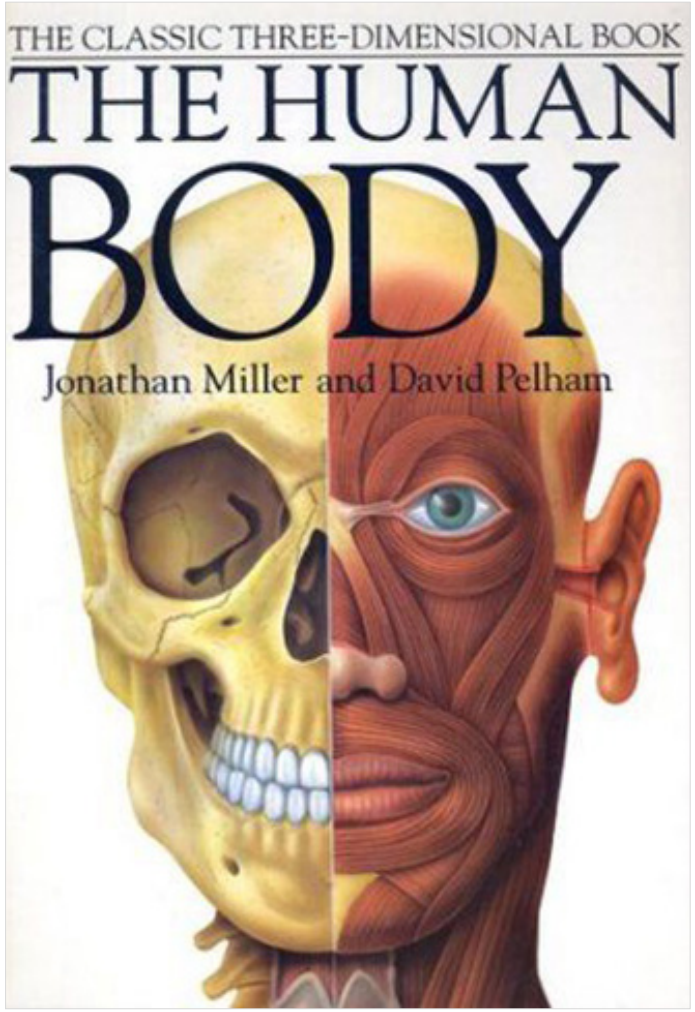

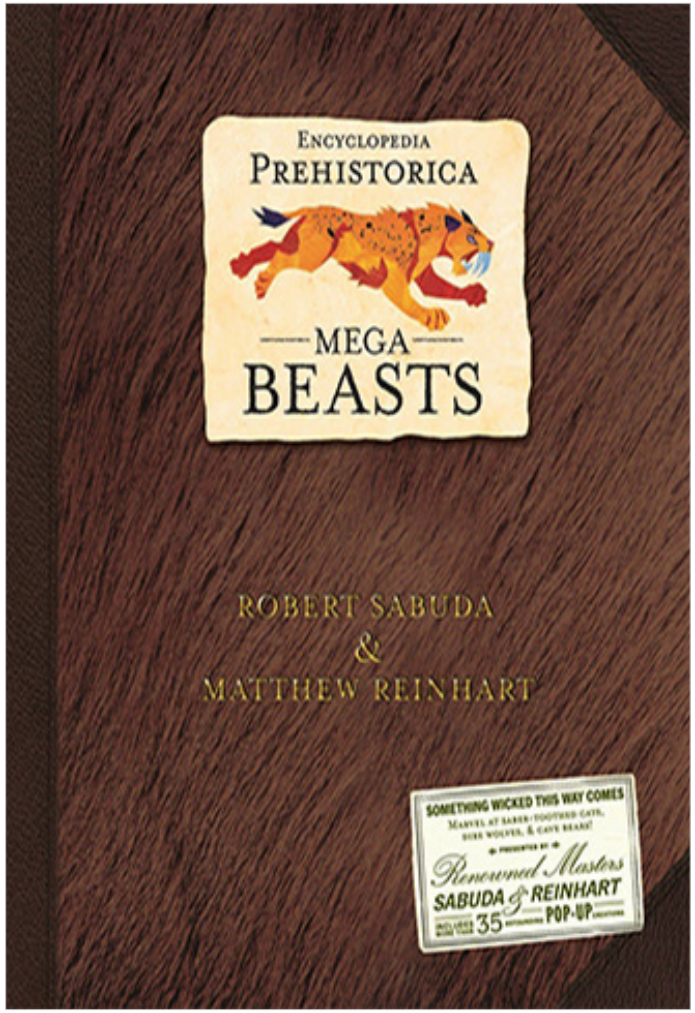

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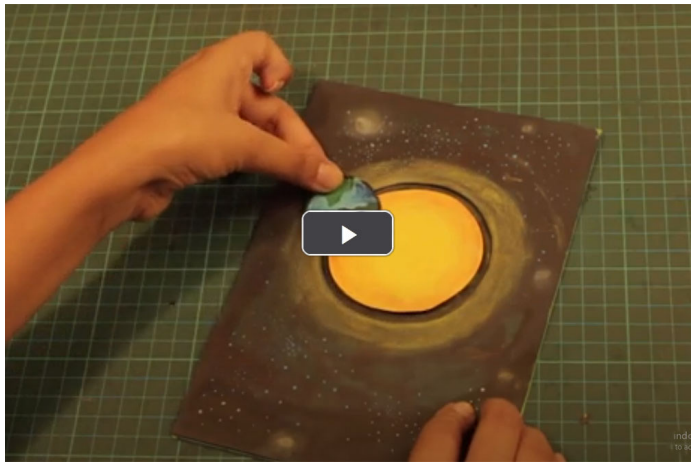
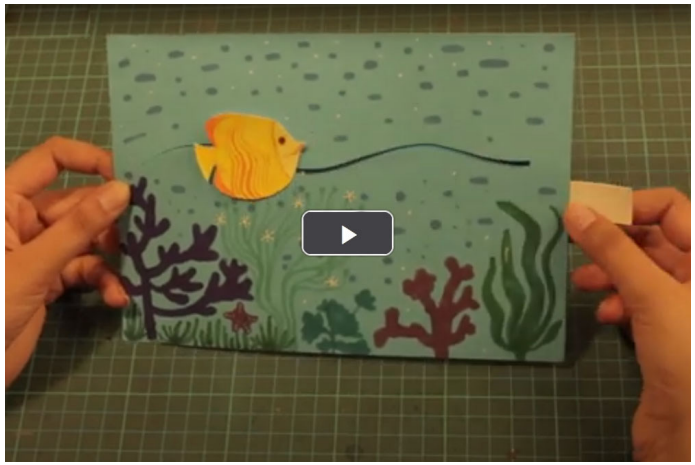
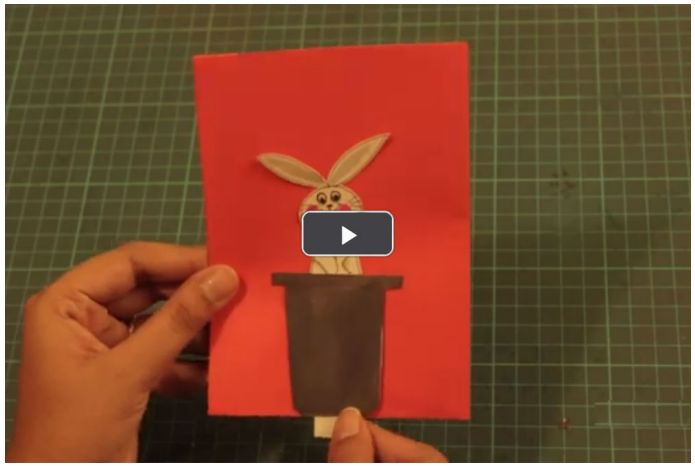


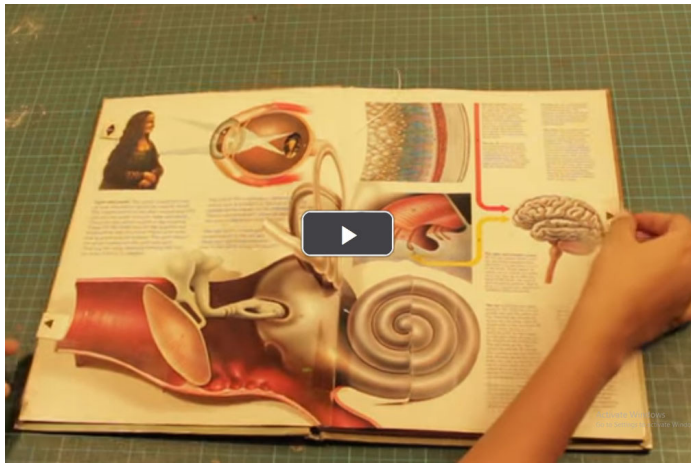
Pop-up Design - Earth



Pop-up Design - Fish



Pop-up Design - Rabbit



Pop-up Design - Human Anatomy

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Contact Details

This documentation was done by Mugdha Kale, Faculty at IDC, IIT Bombay.

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